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THE ELECTRIC LIGHT AT COLCHESTER.

IN last week's issue we furnished our readers with a reprint of a circular issued by the directors of the South-Eastern Brush Company. We also published a very lengthy communication from Mr. George Offor, the manager of that company, to whom we had applied the term "enthusiastic" and to which we must add the epithet of "bold," for we now feel compelled to draw attention to these documents, although it occasions us to go out of our usual path in technical literature into that of commercial operations. We stated in our Notes columns that the letter to which we allude placed the Colchester installation in a more favourable light than we had anticipated, but nevertheless there are many points still involved which demand serious consideration. It will be well to commence with the prospectus issued by the South-Eastern Company.

The objects for its formation are here distinctly stated, but as we understand it, the company was started, as were others at or about the same time, for commercial purposes and not for giving the directors power for the carrying out of scientific experiments. Mr. Offor's letter indicates that the B. T. K. system has been proved a scientific success, but Prof. Forbes's report if it had been favourable—upon which point, however, we must, for reasons before stated, remain silent—would have led to the same conclusion and at much less cost. It is difficult to see therefore that any grain of comfort to assuage the remorse of the poor shareholders can be gleaned from this portion of our correspondent's letter, for it was probably known to most persons that if the apparatus employed would only fulfil its duties, the *system* could not fail to act.

The point to be considered, then, is whether the directors took ordinary business precautions in seeing that suitable apparatus was at command previous to spending the money of the shareholders. We have by us an undated circular issued, we believe, about the beginning of March, 1884, and signed by four of the company's shareholders, Messrs. W. Hewett, jun., R. Braithwaite, J. P. Gillett and G. Wedd, in which attention is called to the above-mentioned query, viz., whether the Consolidated Electric Company could supply certain electrical apparatus, and also stating that the directors of the S. E. Company had been applied to for permission to allow an eminent electrician to examine and report upon the system; further, it pointed out that in the event of failure of the apparatus the patentees would gain experience free of expense, whilst the S. E. Company would have no benefit whatever from the experiments they feared were being undertaken. To these requests the directors replied, under date 8th March, that Prof. Forbes "*is now engaged in making such examination.*" How is it that this report is not yet ready, or, if ready, unpublished?

In another portion of his letter Mr. Offor states that the words "and reduced" operated unfavourably against the commercial success of the concern; but at whose door is the blame to be laid that such words were made necessary? Certainly it is not with the shareholders. Is it not possible that had the directors met the committee which issued the circular to which we have referred in a fair way, the capital need not have been reduced?

In the directors' circular reference is made to the value of the licenses of the Anglo-American Brush Corporation, but is it not a fact that the exclusive right to sell Brush apparatus and Lane-Fox lamps in the district was long ago parted with to the parent company, and that upon all such apparatus sold by the parent company in the same district a small percentage has to be handed over to the S. E. Company? It would be interesting to know what sum has thus been paid by the parent company under this arrangement and over what period of time.

We have by us the report to the shareholders for the year ending June 1883, in which it is stated that "careful estimates have been made of the cost of plant, working expenses, and probable revenue, based upon actual contracts made for the supply of electricity." We again ask where are these estimates, are they the same as those which were read out at the opening of the installation on the 11th June last? If so, were they checked by any independent and reliable authority?

The directors have demurred at the balance-sheet prepared by Messrs. Price, Waterhouse & Co., but we do not see in what particulars they show it to be in error or misleading. They certainly refer to the item of the Consolidated Company, but the committee, if we are rightly informed, were not so well able to judge of this concern or its manufactures as would have been the case had the report of Prof. Forbes been available.

Assuming that the Anglo-American Brush Corporation or some other firm of standing does not buy up the Colchester plant and its belongings, we wonder whether the directors of the S. E. Company would think it advisable to do so from their own purses, for surely, after their jubilant tone respecting its scientific success, they will not let the matter lapse, particularly as there is at least one more point to demonstrate experimentally, *i.e.*, the life of the accumulators. Probably this suggestion has not before been made to the directors, and if therefore they act upon our hint and take the installation over for the full amount expended and not for a mere nominal sum, they would then save the shareholders of the company from the "absolute wreckage" foreshadowed in the last paragraph of their circular.

With regard to the expressions "collapse" and "utter failure" used by us, we do not consider we were very wide of the mark from a commercial point of view. Accepting the statements contained in the docu-

ments, and regarding the system and apparatus as perfect, we can only feel that the management has by no means been immaculate, for seldom, indeed, does it come under one's observation that an efficient and good article, meeting a public want, will not find customers in plenty, if its price be not a fancy one, and if well handled by those responsible for its introduction.

If a man commits an error either of omission or commission, it is no palliation of his offence to point to a second person who has unfortunately been led into the commission of an error still more serious, and the comparison of the work of this company with that of others can bring with it no absolution from the charge of managerial incapacity or thoughtlessness.

And now we would ask in conclusion, how was it that so grievous a mistake should have been made, when estimating the revenue of the company, as to assume that the whole of the lamps in shops and dwellings would be kept alight for the same length of time, a period reckoned as nearly 3½ hours per day, throughout summer and winter? If this question can be satisfactorily answered, then we may reconsider some of our remarks on the management of the company, or on the care which was taken in preparing estimates before the enterprise was embarked in.

ON THE FRITTS SELENIUM CELLS AND BATTERIES.*

By C. E. FRITTS, New York, N.Y.

IN all previous cells, so far as I am aware, the two portions or parts of the selenium, at which the current enters and leaves it, have been in substantially the same electrical state or condition. Furthermore, the paths of the current and of the light have been transverse to each other, so that the two forces partially neutralise each other in their action upon the selenium. Lastly the current flows through not only the surface layer which is acted upon by the light, but also through the portion which is underneath and not affected thereby, and which therefore detracts from the actual effect of the light upon the selenium at the surface.

My form of cell is a radical departure from all previous methods of employing selenium, in all of these respects. In the first place, I form the selenium in very thin plates, and polarise them, so that the opposite faces have different electrical states or properties. This I do by melting it upon a plate of metal with which it will form a sort of chemical combination, sufficient, at least, to cause the selenium to adhere and make a good electrical connection with it. The other surface of the selenium is not so united or combined, but is left in a free state, and a conductor is subsequently applied over it by simple contact or pressure.

During the process of melting and crystallising, the selenium is compressed between the metal plate upon which it is melted and another plate of steel or other substance with which it will not combine. Thus by the simultaneous application and action of heat pressure, chemical affinity and crystallisation, it is formed into a sheet of granular selenium, uniformly polarised throughout, and having its two surfaces in opposite phases as regards its molecular arrangement. The non-adherent plate being removed after the cell has become cool, I then cover that surface with a *transparent conductor of electricity*, which may be a thin film of gold leaf. Platinum, silver, or other suitable material may also be employed. The whole surface of the selenium is therefore covered with a good electrical conductor, yet is practically bare to the light, which passes through the conductor to the selenium underneath. My standard size of cell has about two by two and a half inches of surface, with a thickness of $\frac{1}{1000}$ to $\frac{5}{1000}$ inch of selenium. But the cells can, of course, be made of any size or form. A great advantage of this arrangement consists in the fact that it enables me to apply the current and the light to the selenium in the same plane or general direction, instead of transversely to each other as heretofore done, so that I can cause the two influences to either coincide in direction and action, or to act upon opposite faces of the selenium and oppose each other, according to the effect desired.

By virtue of the process and arrangement described, my cells have a number of remarkable properties, among which are the following:

1. *Their sensitiveness to light* is much greater than ever before known. The most sensitive cell ever produced, previous to my investigations, was one made by Dr. Werner Siemens, which was 14·8 times as conductive in sunlight as in dark. In table A I give results obtained from a number of my cells.

TABLE A.—SENSITIVENESS TO LIGHT.

Selenium cell.	Battery power.	Resistance in dark.	Resistance in sunlight.	Ratio.
No. 22	5 elements	39,000 ohms.	340 ohms.	114 to 1
„ 23*	5 „	14,000 „	170 „	82·3 „ „
„ 24†	5 „	648,000 „	2,400 „	270 „ „
„ 25	5 „	180,000 „	930 „	196·5 „ „
„ 26	5 „	135,000 „	710 „	190 „ „
„ 107	5 „	118,000 „	740 „	159 „ „
„ 108	5 „	200,000 „	900 „	222 „ „
„ 122	5 „	56,000 „	220 „	254·5 „ „
„ 129*	5 „	200,000 „	940 „	212 „ „
„ 137	5 „	108,000 „	320 „	337·5 „ „

It will be observed that I have produced one cell which was 337·5 times as conductive in hazy sunlight as in dark. The tremendous change of resistance involved in the expression "337·5 times" may perhaps be more fully realised by saying that 99·704 *per cent.* of the resistance had disappeared temporarily, under the joint action of light and electricity, so that there remained *less than* $\frac{3}{10}$ *of* 1 *per cent.* of the original resistance of the selenium in dark.

In order to obtain these high results, the cells must be protected from light when not in use. The resistance is first measured while the cell is still in total darkness. It is then exposed to sunlight and again measured. It is also necessary to send the current in at the gold electrode or face, as the cell is much less sensitive to light when the light acts upon one surface of the selenium and the current enters at the opposite surface. When the two influences, the light and the current, act through the gold, in conjunction, their forces are united; and, as every atom of the selenium is affected by the light, owing to the extreme thinness of the plate, we have the full effect shown in the measurements.

Cells which are sensitive to light improve by being used daily, and their sensitiveness becomes less if they are laid aside and not used for a considerable length of time, especially if allowed to become overheated. They should be kept cool, and exposed to light frequently, whether they are used or not.

Mode of measuring cells.—So great is the sensitiveness of these cells to external influences, that it is necessary to adopt some particular system in measuring their resistance and to adhere strictly to that system, as every change in the method of measurement produces a difference in the result, and the different measurements would not be comparable with each other. The reason for this will be explained presently.

The system I have adopted is the Wheatstone

* From the "Proceedings of the American Association for the Advancement of Science," Vol. XXXIII., Philadelphia Meeting, September, 1884.

* Cells No. 23 and No. 129 are now in possession of Prof. W. Grylls Adams, of King's College, London; Dr. Werner Siemens has No. 25, and Prof. George F. Barker, of Philadelphia, has No. 26.

† No. 24 was measured with a bridge multiplier of 6 to 1.

bridge arrangement, with equal sides, never using multipliers except for some experimental purpose. In each multiplier wire I have 500 ohms resistance. When the bridge is balanced, one-half of the current flows through the cell and acts upon the selenium. Between the bridge and the cell is a reversing switch, so that the current can be reversed through the cell without changing its course through the bridge. A Bradley tangent galvanometer is used, employing the coil of 160 ohms resistance. The Leclanché battery is exclusively used in measurements for comparison.

2. *The kind of battery employed* has a marked effect upon the sensitiveness to light, which is largely reduced or entirely destroyed when the bichromate battery is used. The same cells again become extremely sensitive with the Leclanché battery. We might naturally expect that a change in the current employed would cause a change in the *resistance* of a cell, but it is not clear how or why it should affect the *sensitiveness of selenium to light.*

"If one kind of battery current destroys its sensitiveness, may we not suppose that another kind might increase its sensitiveness? Although the Leclanché has operated well, some other may operate still better, and by its special fitness for use on selenium cells may intensify their actions, and so bring to light other properties yet unthought of. Is there not here a promising field for experiment, in testing the various forms of battery already known, or even devising some new form especially adapted to the needs and peculiarities of selenium cells?"

One year ago I made the foregoing suggestion in a paper on "A New Form of Selenium Cell," presented before this Association at Minneapolis. I am now at liberty to state that my photo-electric battery, presently to be described, marks an advance in the direction indicated. The current from this battery increases the sensitiveness of the cells to light, and also to reversal of current. One cell whose highest ratio in light was about 83 to 1, with the Leclanché battery, when measured with my battery gave a ratio of 120 to 1. It seems to make the resistance of the cell both higher in dark and lower in sunlight than with the Leclanché battery. But the field is yet open to others, for the discovery of a battery which may be still better for use with selenium cells.

3. *The two surfaces of the selenium act differently towards currents* sent into them from the contiguous conductors. One surface offers a higher resistance to the current than the other. The former I utilise as the anode surface, as I have found that the cell is more sensitive to light when the current enters at that surface, which is ordinarily the one covered by the gold or other transparent conductor. Some cells have this property but feebly developed; but in one instance the resistance offered to the current by the anode surface was 256 times as high as that offered by the cathode surface to the same current. In the majority of cases, however, the ratio does not exceed 10 times. Table B gives some recent results.

TABLE B.—SENSITIVENESS TO REVERSAL OF DIRECTION OF CURRENT.

No. of cell.	Battery.	Resistance, "gold anode."	Resistance, "gold cathode."	Ratio.
		ohms.	ohms.	
⅛ inch square, No. 4	5 elements	20,000	1,000	20 to 1
⅛ „ „ „ 3	*Sc.* cell	6,500	400	16·2 „ „
Full size, No. 13	1 element	9,000	800	11·2 „ „
„ „ „ 14	5 „	2,440	130	18 „ „
„ „ „ 15	5 „	4,640	210	22 „ „
„ „ „ 27	5 „	6,900	440	16 „ „
„ „ „ 126	1 „	5,000	330	15 „ „

The direction of the current is always indicated by stating the position of the gold electrode—by the terms "gold anode" and "gold cathode." The above measurements were made in dark.

4. *Sensitiveness to change of battery power.*—My cells are extremely sensitive to any change in the strength or character of the current flowing through them, which is shown by a corresponding change in the resistance of the cell. I can, therefore, vary the resistance of one of my cells in many ways, and the following may be specified:—

(*a*) By changing the potential or electromotive force of the current through the cell.

(*b*) By changing the "quantity" of the battery or current.

(*c*) By putting more or less resistance in the circuit.

(*d*) By dividing the current, by one or more branch circuits or shunts around the cell.

(*e*) By varying the resistance in any or all of said circuits.

A cell whose resistance becomes greater as the battery power becomes greater, and *vice versa*, I call an "L B cell" signifying *Like the Battery power.* A "U B cell" is one whose resistance becomes greater as the battery power (or strength of current) becomes less, and *vice versa*, being *Unlike the Battery power* or current strength.

These changes of resistance are not due to heating of the conductor or the selenium, and the following instance will illustrate this. I have one cell in which the selenium had about one-fourth inch square of surface melted on a brass block one inch thick. This cell measured, with 25 elements of Leclanché, 40,000 ohms. On changing the battery to 5 elements the resistance fell instantly to 30 ohms, and there remained. On again using the current from 25 elements, the resistance instantly returned to 40,000 ohms. Had these results been due in any degree to heating, the resistance would have changed gradually as the heat became communicated to the brass—whereas no such change occurred, the resistances being absolutely steady. Moreover, even the fusion of the selenium would not produce any such change.

The "U B" property does not ordinarily change the resistance of the cell to exceed ten times, *i.e.*, the resistance with a weak current will not be over ten times as high as with a strong one. But I have developed the "L B" property to a far higher degree. Table C gives some recent results obtained with L B cells, including one whose resistance, with 25 elements Leclanché, was 11,381 times as high as with 8 elements, and which, after standing steadily at 123 ohms (and then at 325 ohms with 1 element), on receiving the current from 25 elements again returned to its previous figure of 1,400,000 ohms.

TABLE C.—SENSITIVENESS TO CHANGE OF BATTERY POWER.

No. of cell.	Resistance with 25 elements.	Resistance with 5 elements.	Ratio of change.
⅛ inch square, No. 1	40,000 ohms	30 ohms	1,333 to 1
⅛ „ „ „ 2	13,000 „	40 „	325 „ „
¼ „ „ „ 1	1,400,000 „	123* „	11,381 „ „
¼ „ „ „ 2	500,000 „	62 „	8,064 „ „
¼ „ „ „ 5	3,500 „	21 „	167 „ „
Full size, No. 81	68,000 „	121 „	561 „ „
„ „ „ 82	9,000 „	64 „	140 „ „
„ „ „ 83	17,300 „	74 „	233 „ „
„ „ „ 119	35,600 „	19 „	1,894 „ „

The results in the table were obtained by changing the strength of current by throwing in more or less of the battery. Like results can be obtained by varying the current through the cell by any of the other methods before specified. The above measurements were in dark.

5. *Dual state of selenium.*—My cells, when first made, seem to have two states or conditions. In one, their resistance is very low, in the other it is high. When in the low state they are usually not very sensitive in any respect. I therefore raise the resistance

* This measurement was obtained with 8 elements.

by sending an intermittent or an alternating current through the cells, and in their new condition they at once become extremely sensitive to light, currents, and other influences. In some cases they drop to the low state again, and require to be again brought up, until, after a number of such treatments, they remain in the sensitive state. Occasionally a cell will persist in remaining in the insensitive state. The before-mentioned treatment raises it up for a moment, but, before the bridge can be balanced and the resistance measured, it again drops into the low or insensitive state. Some cells have been thus stimulated into the high or sensitive state repeatedly, and every means used to make them stay there, but without avail ; and they have had to be laid aside as intractable.

In the earlier stages of my investigations, before the discovery of this dual state and the method of changing a cell from the insensitive to the sensitive condition, hundreds of cells were made, finished, and tested, only to be then ruthlessly destroyed and melted over, under the impression that they were worthless. Now I consider nothing worthless, but expect sooner or later to make every cell useful for one purpose or another.

The most singular part of this phenomenon is the wide difference in the resistance of the cells in the two states. In the low state, it may be a few ohms, or even a few hundredths of an ohm. In the high state, it is the normal working resistance of the cell, usually between 5,000 and 200,000 ohms, but is often up among the millions. The spectacle of a little selenium being stimulated, by a few interruptions of the current through it, into changing its resistance from a fraction of an ohm up to a million or several millions of ohms, and repeatedly and instantly changing back and forth, up and down, through such a wide range—we might almost say, changing from zero to infinity, and the reverse, instantly—is one which suggests some very far-reaching inquiries to the electrician and the physicist. What is the nature of electrical conductivity or resistance, and how is it so greatly and so suddenly changed ?

6. *Radio-electric current generators.*—My cells can be so treated that they will generate a current by simple exposure to light or heat. The light, for instance, passes through the gold and acts upon its junction with the selenium, developing an electromotive force which results in a current proceeding from the metal back, through the external circuit, to the gold in front, thus forming a photo-electric dry pile or battery. It should preferably be protected from overheating, by an alum water cell or other well known means.

The current thus produced is radiant energy converted into electrical energy directly and without chemical action, and flowing in the same direction as the original radiant energy, which thus continues its course, but through a new conducting medium suited to its present form. This current is continuous, constant, and of considerable electromotive force. A number of cells can be arranged in multiple arc or in series, like any other battery. The current appears instantly when the light is thrown upon the cell, and ceases instantly when the light is shut off. If the light is varied properly by any suitable means, a telephonic or other corresponding current is produced, which can be utilised by any suitable apparatus, thus requiring no battery but the selenium cell itself. The strength of the current varies with the amount of light on the cell, and with the extent of the surface which is lighted.

I produce current not only by exposure to sunlight, but also to dim diffused daylight, and even to lamplight. I have used this current for actual working purposes—among others, for measuring the resistance of other selenium cells, with the usual Wheatstone bridge arrangement, and for telephonic and similar purposes. Its use for photometric purposes and in current regulators will be mentioned farther on. It is undoubtedly available for all uses for which other battery currents are employed, and I regard it as the most constant, convenient, lasting, readily used and easily-managed pile or battery of which I have any knowledge. On the commercial scale it could be produced very cheaply, and its use is attended by no expense inasmuch as no liquids or chemicals are used, the whole cell being of solid metal with a glass in front for protection against moisture and dust. It can be transported or carried around as easily and safely as an electro-magnet, and as easily connected in a circuit for use wherever required. The current, if not wanted immediately, can either be "stored" where produced, in storage batteries of improved construction devised by me, or transmitted over suitable conductors to a distance and there used, or stored as usual till required.

7. *Singing and speaking cells.*—When a current of electricity flowing through one of my selenium cells is rapidly interrupted, a sound is given out by the cell, and that sound is the tone having the same number of air vibrations per second as the number of interruptions in the current. The strength of the sound appears to be independent of the direction of the current through the cell. It is produced on the face of the cell, no sound being audible from the back of the cell. An alternating current also produces a sound corresponding to the number of changes of direction. Experiments also show that if a telephonically undulating current is passed through the cell, it will give out the speech or other sound corresponding to the undulations of the current ; and, furthermore, that the cell will sing or speak in like manner, without the use of a current, if a suitably varied light is thrown upon it while in closed circuit.

My experiments having been devoted especially to those branches of the subject which promised to be more immediately practically valuable, I have not pursued this inquiry very far, and offer it for your consideration as being not only interesting, but possibly worthy of full investigation.

General Observations on the Properties of Cells.

From the number of different properties possessed by my cells, it might be anticipated that the different combinations of those properties would result in cells having every variety of action. This is found to be the case. As a general rule the cells are noteworthy in one respect only. Thus, if a cell is extremely sensitive to light, it may not be specially remarkable in other respects. As a matter of fact, however, the cells most sensitive to light are also "U B cells."

The property of sensitiveness to light is independent of the power to generate current by exposure to light, the best current-generating cells being only very moderately sensitive to light, and some of the most sensitive cells generate scarcely any current at all. Current-generating cells are, almost without exception, "U B cells ;" and the best current-generating cells are strongly polarised, showing a considerable change of resistance by reversing the direction of a current through them ; and they are also strong "anode cells," *i.e.*, the surface next to the gold offers a higher resistance to a battery current than the other surface of the selenium does. The power to generate a current is temporarily weakened by sending a battery current through the cell while exposed to light, in either direction. The current generated by exposure to light is also weakened by warming the cell, unless the cell is arranged for producing current by exposure to heat.

The properties of sensitiveness to light and to change of battery power are independent of each other, as I have cells which are sensitive to change of current but absolutely insensitive to light, their resistance remaining exactly the same whether the cells are in darkness or in sunlight. I also have cells which are sensitive to light, but are unaffected by change of battery power, or by reversing the direction of the current through them.

The sensitiveness to change of battery power is also independent of the sensitiveness to reversal of direction of the current. Among the best "L B cells," some are "anode cells" and others are "cathode cells,"

while still others are absolutely insensitive to reversal of current, or to the action of light.

Constancy of the resistance.—A noticeable point in my cells is the remarkable constancy of the resistance in sunlight. Allowing for differences in the temperature, the currents, and the light at different times, the resistance of a cell in sunlight will remain practically constant during months of use and experiments, although during that time the treatments received may have varied the resistance in dark hundreds of thousands of ohms, sometimes carrying it up, and at others carrying it down again, perhaps scores of times, until it is "matured" or reaches the condition in which its resistance becomes constant.

As has already been stated, the sensitiveness of a cell to light is increased by proper usage. This increased sensitiveness is shown, not by a lowered resistance in light, but by an increased resistance in dark. This change in the cells goes on, more or less rapidly, according as it is retarded or favoured by the treatment it receives, until a maximum is reached, after which the resistance remains practically constant in both light and dark, and the cell is then "matured" or finished. The resistance in dark may now be 50 or even 100 times as high as when the cell was first made, yet, whenever exposed to sunlight, it promptly shows the same resistance that it did in the beginning. The various treatments, and even accidents, through which it has passed in the meantime, seem not to have stirred its molecular arrangement under the action of light, but to have expended their forces in modifying the positions which the molecules must normally assume in darkness.

Practical applications.—There are many peculiarities of action occasionally found, and the causes of such actions are not always discernible. In practice I have been accustomed to find the peculiarities and weaknesses of each cell by trial, developing its strongest properties and avoiding its weaknesses, until, when the cell is finished, it has a definite and known character, and is fitted for certain uses and a certain line of treatment, which should not be departed from, as it will be at the risk of temporarily disabling it. In consequence of the time and labour expended in making cells, in the small way, testing, repairing damages done during experiments, &c., the cost of the cells now is unavoidably rather high. But if made in a commercial way, all this would be reduced to a system, and the cost would be small. I may say here that I do not make cells for sale.

The applications or uses for these cells are almost innumerable, embracing every branch of electrical science, especially telegraphy, telephony and electric lighting, but I refrain from naming them. I may be permitted, however, to lay before you two applications, because they are of such general scientific interest. The first is my

Photometer.—The light to be measured is caused to shine upon a photo-electric current-generating cell, and the current thus produced flows through a galvanometric coil in circuit, whose index indicates upon its scale the intensity of the light. The scale may be calibrated by means of standard candles, and the deflections of the index will then give absolute readings showing the candle-power of the light being tested. Or, the current produced by that light and that produced by the standard candle may be compared, according to any of the known ways of arranging and comparing different lights—the cell being lastly exposed alternately to the two lights to see if the index gives exactly the same deflection with each light.

This arrangement leaves untouched the old difficulty in photometry, that arising from the different *colours* of different lights. I propose to obviate that difficulty in the following manner. As is well known, gold transmits the green rays, silver the blue rays, and so on; therefore, a cell faced with gold will be acted upon by the green rays, one faced with silver by the blue rays, &c. Now if we construct three cells (or any other number) so faced that the three, collectively, will be acted upon by all the colours, and arrange them around the light to be tested, at equal distances therefrom, each cell will produce a current corresponding to the coloured rays suited to it, and altogether will produce a current corresponding to all the rays emitted by the light, no matter what the proportions of the different colours may be. The three currents may act upon the same index, but each should have its own coil, not only for the sake of being able to join or to isolate their influences upon the index, but also to avoid the resistances of the other cells. If a solid transparent conductor of electricity could be found which could be thick enough for practical use and yet would transmit all the rays perfectly, *i.e.*, transmit white light unchanged, that would be still better. I have not yet found a satisfactory conductor of that kind, but I think the plan stated will answer the same purpose. This portion of my system I have not practically tested, but it appears to me to give good promise of removing the colour stumbling-block which has so long defied all efforts to remove it, and I therefore offer it for your consideration.

Photo-electric regulator.—My regulator consists of a current-generating cell arranged in front of a light, say, an electric lamp whose light represents the varying strength of the current which supports it. The current produced in the cell by this light flows through an electro-magnetic apparatus by means of which mechanical movement is produced, and this motion is utilised for changing resistances, actuating a valve, rotating brushes, moving switches, levers or other devices. This has been constructed on a small scale and operates well, and I think it is destined to be largely used, as a most sensitive, simple and perfect regulator for currents, lights, dynamos, motors, &c., &c., whether large or small.

In conclusion, I would say that the investigation of the physical properties of selenium still offers a rare opportunity for making very important discoveries. But candour compels me to add that whoever undertakes the work will find it neither an easy nor a short one. My own experience would enable me to describe to you scores of curious experiments and still more curious and suggestive results, but lack of time prevents my giving more than this very incomplete outline of my discoveries.

THE POWER EXPENDED IN ELECTRIC LIGHTING.

IT may be assumed that the majority of electrical engineers are capable of determining where the various losses occur in electric lighting, from the initial power given out by the prime mover to the energy which is actually utilised in the lamps. Still, any experimental data on this subject will always be of considerable value; and when coming from such a pen as that of Mr. Gisbert Kapp it will be doubly welcome. This gentleman, in a communication to the *Engineer*, says:—

The power required for driving the dynamo is generally a very important item in the total cost of working an electric light installation.

The waste occurs throughout the whole system at every step of transmission or transformation of energy. There is a loss of power within the engine, the actual horse-power of which is always smaller than the indicated horse-power; there is a further loss in the gear by which the power is transmitted to the dynamo. In the dynamo itself there are several distinct losses which are necessary accompaniments of the transformation of mechanical into electrical energy, and the wires which carry the current to the lamps are heated by it, and this heat has to be paid for by an increased consumption of fuel under the boiler. In the case of arc lamps a slight loss occurs in the lamp itself, by reason of the electrical energy required for the proper control and "feed" of the lamp.

In the dynamo the causes of loss of power are neither generally known nor easily traceable, and very as-

tounding statements have at various times been put forward by makers of dynamos, or by other interested parties, without it being possible to easily verify or refute such statements.

When a dynamo is at work the external wire on the armature is being moved rapidly along, and within a very small distance from the polar surfaces of the field magnets experience a resistance which is the greater the stronger the magnetic field, the quicker the speed, and the greater the current. The energy represented by the product of this resistance into the speed of rotation is transformed into internal electrical energy, which can be expressed by the product of current and internal electromotive force. In a perfect machine this ought to equal the power applied to the spindle of the armature, but in reality more has to be applied, because some power is required for the mechanical friction in the journals, for churning the air, and for an additional electro-magnetic resistance which can best be described by the term "magnetic friction."

Of the total electrical energy created in the wire coils of the armature a certain proportion only is received at the commutator, where the brushes take the current off, the remainder being lost through electrical resistance. The lower this resistance the better, and in this respect an enormous improvement has within the last year or two been made by nearly all the manufacturers of dynamos. It was at one time thought necessary to multiply the number of convolutions on the armature, in order to get up the required electromotive force, and thus the resistance of the armature was not only high, but it also had a large coefficient of self induction, causing considerable sparking at the brushes, which involved an additional loss of power. Now electricians have learned how to obtain a high electromotive force by simply putting plenty of iron into the armature and employing a smaller number of convolutions with a proportionate reduction of resistance, and having the additional advantage of perfect freedom from sparking. Both these results are attended by a considerable saving of power. The latest published test of an Edison-Hopkinson dynamo shows a loss in the armature of only 4·4 per cent. of the total electrical energy developed, and other machines are equally good in that respect, as will be seen from the tables given below.

Not all the electrical energy flowing from the commutator into the brushes is available for external use. Part of it has yet to be sacrificed for producing the magnetic field. How large a part depends on the type and design of the machine, on its size and on the quantity and quality of the iron forming the magnet cores. The latter point is of great importance. Iron of the softest quality and plenty of it is the secret by which this loss can be made very small. The author has found that cast iron magnets require from 2 to 2½ times as much exciting power as magnets of soft Swedish wrought iron thoroughly annealed. The loss of energy in exciting the field magnets varies between 2½ and 15 per cent. of the total electrical energy developed. After deducting these various losses we obtain the energy actually available for external work, or, as it is technically termed, the "electrical output." To make this article of some use to practical engineers, some tables are given below containing results obtained with different machines. It is much to be regretted that neither the jury of the Vienna Exhibition, nor that of last year's Health Exhibition, have as yet published their report on dynamos; and thus we are forced to fall back on the Munich tests as the only available authoritative record of the performance of various dynamos.

In spite of its antiquity, the Munich report has considerable interest—partly because many hundreds of machines similar to those tested are now in use, and are likely to remain in use for many years—for dynamos hardly ever wear out—and partly because it serves to show the progress made in dynamo construction within the last two or three years. The report on the Munich tests contains a number of very minute tables, and a short abstract containing average values is given below. All the figures are percentages of the total horse-power transmitted into the dynamo. The first column gives the loss of power due to churning of air, to mechanical friction of journals, and to magnetic friction; the second column gives the loss in armature; the third the loss in exciting the field magnets; and the fourth the actual electrical output:—

Type.	Friction.	Armature.	Field.	Output.
Edison ...	34·00	2·76	5·80	57·44
Bürgin ...	9·25	13·75	12·20	64·80
Schwerd ...	13·50	6·95	11·05	68·50
Schuckert ...	7·90	9·15	10·90	72·05
Schuckert ...	19·20	8·30	9·90	62·60

From this table it appears that with the older form of dynamo an average output of about 65 per cent. is obtainable. In modern machines the percentage recovered varies between 70 and 80, and in some exceptional cases it may reach as high as 85 per cent. Experiments which the author has made with some Crompton dynamos have shown an output of about 80 per cent. of the power applied, and other modern machines are probably equally good. As an example may be cited the Schuckert-Mordey dynamo, a test of which, kindly forwarded to the author by Mr. Mordey, is given below.

The machine tested was a D_2 Victoria compound dynamo, driven through a White's transmission dynamometer, which indicated 11·2 horse-power.

Horse-power given out in external circuit	9·480	or 84·2 per cent.
Horse-power lost in armature	·512	or 4·6 „
Horse-power lost in series coils on field magnets	·393	or 5·2 „
Horse-power lost in shunt coils on field magnets	·187	
Horse-power lost in magnetic and mechanical friction	·628	or 6·0 „
Total	11·2	

This is an exceptionally good performance, and it is probable that the machine working at any other speed or output would have shown a somewhat lower efficiency. But within reasonable limits, we may safely take it that it will yield in electrical output about 80 per cent. of the power applied.

Whether large or small dynamos are more economical has long been a moot point with electricians, but at present the balance of opinion is rather in favour of large machines. From a number of trials the author has made with Crompton machines for 60 and 200 lights the following average figures have been obtained, giving the loss in percentage of the total electrical energy:—

Loss in armature ...	14·00, 60 lights ...	3·55, 200 lights.
Loss in field magnets	12·50 „ ...	3·90 „

These losses are, however, considerably influenced by the speed of the machine. It will be evident that the slower the machine runs the larger must it be to produce a given electrical output; and since it must take more energy to excite a large magnet as compared with a small one, we must expect to find a greater loss in slow speed machines. Experience confirms this, and in the case of a 350-light machine running at only 500 revolutions per minute, the loss was found to be—in armature, 5·65 per cent.; in field magnets, 5·42 per cent. By the courtesy of Mr. Crompton, the author is able to give below the results of some tests made at the Victoria Central Station. There are two large dynamos worked by belts from a countershaft on the first floor and two vertical compound engines on the ground floor, which drive the countershaft by belts from the flywheel and through two friction couplings. Only one of the engines is at work at a time, the other being in reserve. At present the engines are not fully loaded, and hence the following table of power test should only be considered as a preliminary one; but the author has thought it better to give the tests, incomplete though they be, because information of this nature is generally

very difficult to obtain. The trial extended over three days; on the first the speed of the engine was about 150 revolutions, and since the load was only light the proportion of engine-friction to total power came out rather high. On the second and third trial this defect was remedied by placing larger pulleys on the countershaft and running the engine only up to 100 revolutions a minute. At the same time the lubrication of the journals of the countershaft was gradually made more perfect, and a corresponding saving of power was effected. The mechanical friction of the dynamo and the power required to drive the fan for cooling the armature was found by running the dynamo when the field magnets were not excited, and the magnetic friction has been computed as the difference between the power put into the dynamo and its internal electrical energy. This was the only way possible with the plant at disposal, but it is not an accurate method on account of the difficulty of estimating exactly the power lost in such a complicated system of driving gear. Hence the figures in the line headed "Magnetic fricton" are of a somewhat erratic character, and can only be taken as rough approximations. The horse-power required to excite the field magnets is inclusive of the loss in the rheostats by which the potential of the machines was regulated. It will be seen that the proportion of electrical output to indicated power is most favourable where the load is greatest, and had there been a third dynamo and a corresponding increase of current, it is probable that the figure instead of being 66 per cent. would have come out at 70 per cent. Now the loss of potential between the dynamos and the lamps is 5½ volts, the lamps being 110 volts, and we receive thus for every horse-power indicated an electrical energy of 492 watts at the lamps. The lamps require 3·25 watts per candle-power, and thus every indicated horse-power produces 151 candles of actual light.

Returning to our general problem, we have yet to consider the loss of energy in the leads and lamps. As regards incandescent lighting in private establishments, the loss in the main leads must always be very small, for the simple reason that a great difference of potential at various points of the circuit would be fatal to the independence of one lamp from the other. A variation of 2 per cent. in the electromotive force can already be detected by an experienced observer, and if a greater variation were to be allowed it would be impossible to switch out a group of lamps near the dynamo without at the same time causing the lamps at the far end of the circuit to brighten up considerably.

As regards arc lighting the case is different. The lamps are generally placed at considerable distances apart, and being connected in series, the loss of potential in the leads has no effect on the lamps as long as the dynamo is sufficiently powerful to keep up the proper current. The energy required at each lamp varies with the illuminating power of the lamp, but not in simple proportion. It also depends on the size and quality of the carbon, the length of arc, and the more or less perfect feed of the lamp. To give any kind of rule applicable to all cases is next to impossible, but as a fair average we may take it that a continuous current of 15 to 17 ampères will, with good carbons, give a light of 2,000 candles measured on an angle of 45° to the horizon, the difference of potential between the carbon points being 45 volts. The shunt coil of such a lamp will require about 0·25 ampère, and the main coil will have a resistance of about 0·1 ohm, so that the total energy which is required for regulation can be taken as 37 watts, corresponding to a loss of 5 per cent. of the total electrical energy supplied to the lamp. The loss in the cable is a most variable quantity, and must be determined specially in each case, but for a rough preliminary estimate it will generally suffice if we allow a loss of about 3 volts per lamp. We can safely reckon that with modern good dynamos, the electrical output varies between 70 per cent. for small machines, and 80 per cent. for large ones. The leads in incandescent lighting absorb 2½ per cent of the output, or 1·75 per cent. of the mechanical energy if small machines are used, and 2 per cent. if large machines are used, thus bringing the percentage of power actually converted into light down to 68·25 and 78 respectively. Incandescent lamps are now made which have a long life if worked at 3·25 watts per candle, and with such lamps the amount of light received for each horse-power expended will be 154 candles with small dynamos, and 176 with large dynamos. On account of difficulty and danger in using currents of very high electromotive force, arc light dynamos are generally made of small or moderate size, and their output can be taken at about 70 per cent. It will therefore take 1·58 horse-power to produce a light of 2,000 candles, which is at the rate of 1,260 candles per horse-power applied to the dynamo.

	Victoria trials, October 7th, engine 144—150 revs.											Ditto, Oct. 14th, 98—100 revs.				Ditto, October 17th, engine 98—100 revs.				
	Two dynamos.									One dynamo.		One dynamo.				Two dynamos.				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	1	2	3	4	5
Engine friction	23·4	23·8	23·8	26·5	25·5	27·5	27·5	26·6	27·5	23·5	23	22·5	22	21·7	20·4	31	30·7	31·2	33·3	15·3
Slatting and belting friction	21	21	21	21	21	21·5	21·5	21	21	20	20	19·5	19·5	18	17	8·75	8·75	8·75	9	8·5
Mechanical friction of dynamo, fan, &c.	4·04	4·0	4	4	4	4	4	4	4	2·1	2·1	2	2	2	2	4	4	4	4	4
Magnetic friction	2·05	1·95	1·8	4·15	·03	4·09	4·2	6·2	7·7	16·06	12·87	4·6	4·2	1·9	2·6	8·8	?	9·8	3·41	1·42
Loss in armature	1·51	1·52	1·55	1·45	1·51	1·51	1·5	1·4	1·4	2·24	2·28	2·4	2·4	2·6	2·4	3·25	3·6	3·95	4·44	·575
Loss in field-magnets and resistances	6	6	6	6	6	6	6	6	6	3	3	3	3·1	3·1	3	6	6·6	5	5·75	6
Net electrical output at terminals of dynamo	45	46	45·5	47·5	49·5	52·6	51	48·8	47·8	31·7	31	34·7	34·7	37·1	34	92	102	92·5	106	40·7
Total indicated horse-power	103	103·2	103·15	110·6	107·8	117·2	115·7	114·4	115·4	98·6	94·25	88·7	87·9	86·4	81·4	153·8	152·5	155·2	165·9	76·5
Percentage of net electrical to gross indicated horse-power	44	44·5	44	42·7	46	45	44	42·5	41·6	32	33	38·8	39·5	43	42	60	66·6	59·5	64	53

PAULSON'S SELF-PROPELLING AND STEERING TORPEDO.

DURING the recent discussions on the efficiency of our navy in the columns of many of our contemporaries, certain points have not, in our opinion, received that attention which their importance demands.

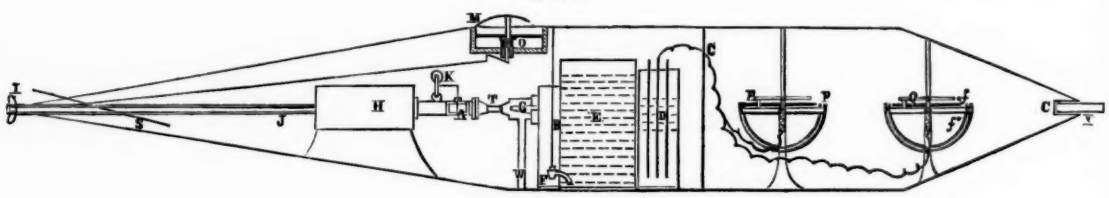
As an efficient means for the defence of our coaling stations, our colonies, and even of our own coasts, we illustrate a new form of self-propelling and steering

torpedo, designed and patented by Mr. Richard Paulson, of Boon Hills, Langwith, Notts. That torpedoes will play an important part in the next naval war is, thinks the *Mechanical World*, evident from the fact that great activity is being displayed by the various governments of the world in the construction of this weapon. Our own Government also has latterly paid great attention to this subject.

The methods hitherto proposed for propelling torpedoes have been by means of carbonic acid or other compressed gas carried by the torpedoes, and by means of electricity conveyed by a conductor leading from a controlling station to electrical apparatus carried by the torpedo. The first method has, to a considerable extent, failed on account of the inefficient way in which the compressed gas was employed to propel the torpedo. The second is open to the objection that by means of telephones placed in the water, or by other signalling apparatus, the torpedo can be heard approaching whilst yet at a considerable distance, and that a quick speeded dredger, kept ready for the purpose when any attack is expected, can be run between the torpedo and the controlling station and the conductor cut and the torpedo captured. The arrangements for steering by means of an electrical conductor from a controlling station are also open to the latter objection. The torpedo we now illustrate, in elevation in fig. 1, and in plan in fig. 2, is designed to obviate these objections, operated by means hereafter described, so as to diminish the stream of water on one side and increase it on the other, so that one motor, and consequently the corresponding propeller, is driven at a higher speed than the other, and so steers the torpedo.

The valve, A, is operated automatically by the following arrangement :—A mariner's compass, P, placed in the head of the torpedo has its needle connected to one pole of a powerful battery, D. A dial of non-magnetic material marked with the points of the compass is capable of being rotated by the connections shown. This dial carries two insulated studs, *p*, each electrically connected with one terminal of the coils of an electro-magnet, K, whose other terminal is connected to the other pole of the battery. These two magnets are arranged on opposite sides of an armature fixed on a lever operating the disc or valve, A. Before launching the torpedo the dial is set, so that when the torpedo is steering direct for the object to be struck, or other desired point, one end of the needle of the compass, P, is between the two studs, *p*, but in contact with neither, the needle of course pointing to the magnetic north. Should the torpedo, however, deviate from this course, the needle makes contact with one or other of the studs, according to the direction in which the deviation takes place, and completes the circuit through the corresponding electro-magnet, which attracts the armature and causes the disc to move, so as to diminish the supply of

FIG. 1.



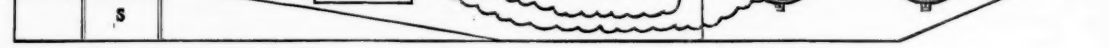


FIG. 2.

and possesses, in addition, other advantages which will be enumerated in the following description.

As stated above, the torpedo is self-propelling, the necessary energy being stored up in liquified carbonic acid contained in a cylindrical vessel, E, carried by the torpedo. The vessel, E, communicates, by means of a small bent pipe extending nearly to its bottom, with a small chamber, B, the passage of the liquid being controlled by means of the cock or tap, F. The chamber, B, is in communication, by means of a small aperture, with the nozzle, G, of an injector, T, constructed on the ordinary principles. The liquid as it passes into the chamber, B, volatilises, and the gas passes through the nozzle of the injector which is surrounded by water in direct communication with the sea by means of the opening, W. The gas imparts its energy in the well-known manner to the water, being itself entirely or partially condensed, the water thus charged with carbonic acid gas being forced through the combining cone of the injector at a very high speed and pressure. Preferably the water is here divided into two streams, each driving a separate rotary motor or turbine, H, themselves driving twin screws or propellers, I. The motors exhaust into the hollow shafts, J, of the propellers, which are extended some distance beyond the propellers, so that the remaining energy of the water may be utilised to aid in propelling the torpedo on the well-known principle of jet propulsion. The torpedo is preferably steered by means of the twin screws. A disc or other valve, A, is pivoted in an aperture in a diaphragm, dividing the outlet of the injector, and is water to one motor and increase it to the other, and so cause the torpedo to again assume the required direction. Supposing the object which it is intended that the torpedo should strike be a large mass of iron, such as an ironclad, the needle will be attracted, and, making the corresponding contact, will cause the torpedo to be steered directly away from the object. In order to prevent this, a second compass, Q, is mounted in the front of the torpedo, and when attracted by a mass of iron, it short-circuits the battery, D, and thus prevents the armature being attracted, and, consequently, the torpedo from deviating. This needle is also capable of slight movement in a vertical plane, so that when passing over or under a mass of iron, it is attracted downwards or upwards and completes a circuit by means of the stops, which operates so as to explode the charge. The charge can also be exploded in the ordinary manner, viz., by means of the firing pin, X, when the torpedo runs into any solid object.

The depth at which the torpedo travels below the surface of the water is regulated by means of a flexible diaphragm, M, secured in the outer casing and connected to a rod sliding freely in fixed bearings. A spiral, or other spring, O, is compressed between a collar on the rod and an adjustable fixed nut, by which the tension of the spring is regulated so that the pressure of water on the diaphragm, A, when the torpedo is at the desired depth just counterbalances the pressure of the spring, the diaphragm being then flush with the outer casing. The rod is connected by suitable levers to two horizontal fins, S, pivoted one on either side of the torpedo, so that

they shall be in equilibrium. Should the torpedo sink too deep or rise too high, the diaphragm will be depressed or extended, and will operate on the fins so as to cause the torpedo to ascend or descend as the case may be.

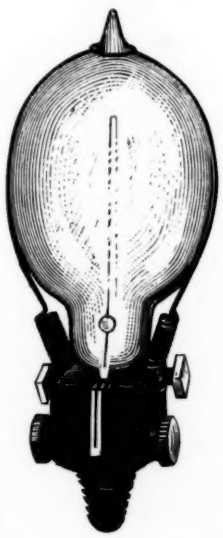
In order to avoid the risk of a spent torpedo destroying a friendly vessel, a valve is arranged in any suitable part of the outer casing, and is weighted or loaded with a spring in such a manner that when under weigh the pressure of the water keeps the valve closed, but when it stops the valve opens and admits water to sink the torpedo.

This invention appears to our contemporary to be sufficiently important to be worthy of a trial by our own Government, and we understand that the United States officials are favourably impressed with it and intend to give it a fair trial with a view to its subsequent adoption.

A NEW LAMP HOLDER.

WE have received from Messrs. Harrison, Cox-Walker & Co. a sample of a new holder for incandescence lamps, which has just been patented and is now manufactured by that firm.

A great amount of ingenuity is being generally displayed amongst electrical engineers in designing lamp-holders which are at once simple, elegant, and capable of making and preserving good electrical contact. The apparatus shown in the sketch appears to possess in the last important point considerable advantages over the bulk of such articles. Should, however, the lamp be at times subjected to any side movement when being handled, it might be expected that the platinum loops would break off; but this, of course, may be avoided by extra tenderness in manipulation.



The patentees state that in nearly all lampholders hitherto made, the small hooks which pass through the terminal loops on incandescent lamps give rise to a very considerable amount of resistance and consequent loss of light, owing to the exceedingly minute point of actual contact between them. Cox-Walker's new holder is so constructed as to make the best possible contact between the loops and the terminals in the holder; and, at the same time, it provides an additional support for the lamps where considered desirable.

The body of the holder is three-quarters of an inch square, with a deep groove across the middle, in which are fixed flat nipping springs or pieces of metal, to which the terminals are attached. The loops in the lamps are placed between the springs, and two milled-headed screws nip the springs together, and thus hold the loops by the sides perfectly tight, making the best possible electric contact.

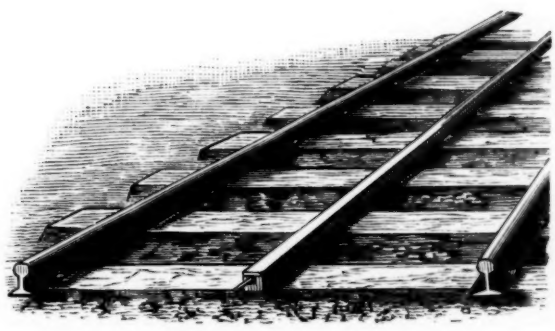
The wire supports are made in various sizes to suit requirements, and add considerably to the appearance of the holder.

We may add that these articles possess another important advantage in the shape of cheapness.

TELEGRAPHING FROM MOVING RAILWAY TRAINS.

ON the afternoon of the 13th February, three special cars left the Grand Central Depot over the New York and New Haven Railroad filled with electricians, engineers, and railroad men, with the object of witnessing the operation of the newly-invented system of railway telegraphy of the Phelps' Induction Telegraph Company, by means of which telegraphic communication is to be had at any time between a moving train and any station on the line. We read in the New York *Electrical Review* that the general principle on which this system acts is simply that of dynamic induction. If the current flowing in a primary circuit be broken whilst a portion of another metallic closed circuit lies parallel to it, a momentary current will be produced by inductive action in this secondary circuit, and its flow will be in the same direction as that of the inducing current; again, if the primary circuit be closed, a momentary current will be induced in the secondary circuit, but this time in the opposite direction to that of the inducing current.

In this system of telegraphy, a wire conductor laid between the rails constitutes the primary circuit, and the secondary circuit consists of a wire circuit which passes along the ceiling of the car, thence down and under the body parallel to and within about seven inches of the primary wire; it joins the upper end and thus forms a closed circuit; by means of these two circuits and an auxiliary local battery circuit on the train, the messages are received and transmitted.

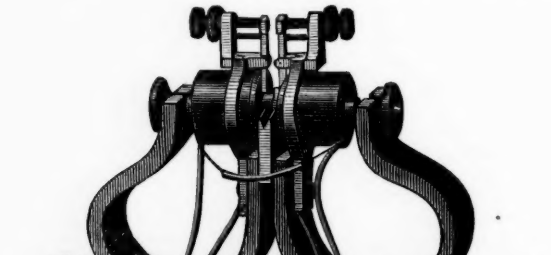


LINE CONDUCTOR.

The main line conductor is secured and protected upon the track in the following manner:—Blocks of wood are first nailed upon the ties midway between the rails. These blocks are so "graded" that when they are in place their upper surfaces will be on a level with the top of the rails. When the blocks are in place string pieces, two inches square with a groove in the top, are nailed upon them; the groove contains the wire, which in the present case is a No. 12 American Gauge insulated wire; and when this is in place, a cover of wood three-eighths of an inch thick is nailed down, and over the joints a strip of galvanised wire two inches wide is securely nailed. At switches and crossings, where a rail crosses the track, the grooved strips are brought up to the rail on both sides and the wire carried under it in a stout rubber tube. The ends of this tube are carried up into the boxes and along inside for a short distance as a protection against dampness and injury. At highway crossings a groove is cut

in the planking of sufficient size to receive a half inch gas pipe instead of the boxing; the pipe is fastened down with staples and the wire passed through. In the equipment of the car, as the whole system depends upon the induction between parallel wires, it is self-evident that it is desirable to have the wires parallel for as long a distance as possible. In the present case a two inch gas pipe is suspended seven inches above the track.

This pipe contains a one and a quarter inch rubber hose, incased in which are 90 convolutions of No. 14 (A.G.) copper wire, single braided and paraffined, and so connected as to form one continuous circuit about a mile and one-half long, and presenting about three-quarters of a mile of wire parallel with the primary line wire between the tracks. The return portion of

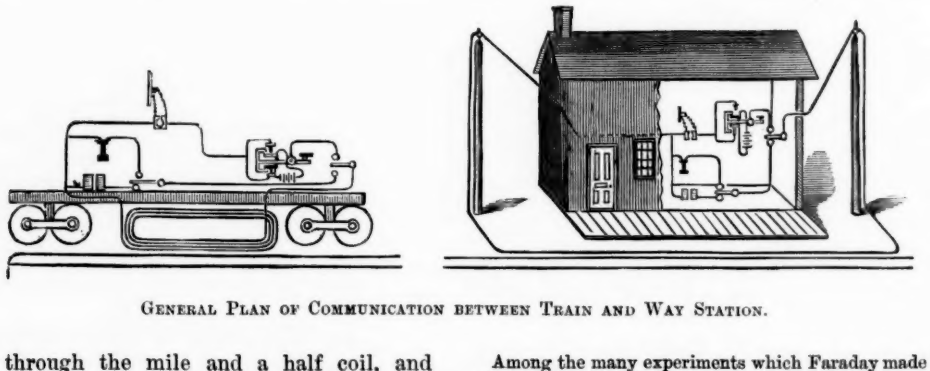


RELAY ON CAR.

this coil is carried in the same rubber hose back through the upper part of the car, the object being to have it removed as far as possible from the lower branch. The terminals of this car circuit are carried to a key for transmitting, and through the back contact of the key to a very delicate polarised relay, invented by Mr. Phelps; this is the receiving instrument upon the car and responds to every reversal of the polarity of the current over the primary or line wire.

A sounder situated upon an elevated sounding box is actuated by the relay in the ordinary manner.

The transmission from the car is effected in the following manner:—The battery upon the car consists of only five one quart battery cells. One of these cells is used to actuate the local sounder and the other four for transmission. The current from these four cells is passed through the front contact of the key before



GENERAL PLAN OF COMMUNICATION BETWEEN TRAIN AND WAY STATION.

mentioned, through the mile and a half coil, and through a "buzzer" which serves to break the current very rapidly, and to cause a humming like that of a bee. This buzzing is broken up into Morse characters by the key and received in a telephone at the terminal station.

In transmitting from the terminal station to the car a battery is used which will give a current of about one and one-half ampères over the line, and manipulated by a pole changing key of special form—also the invention of Mr. Phelps.

The plant which was used for this test, and which has been in successful operation for several weeks, comprises 12 miles of track, of which three miles are trestle work. There are two rivers with drawbridges, one requiring 110 feet of cable and the other 175 feet of cable. The wire is carried underneath the iron rails in 26 places.

There are 47 highway crossings where the wire is carried in an iron pipe. At Harlem River Station the wire is returned upon two side tracks, and at New Rochelle it is carried for about half a mile upon poles. The day was quite unpleasant, a heavy snow storm prevailing all the afternoon. This, however, seemed to have not the slightest effect upon the inductive action of the primary current, for during the entire test a current of very satisfactory strength exhibited itself in the secondary circuit. Whilst it is impossible to speak of the experiment as an *unqualified* success, the failure to attain it was due, not in the least to fault by principle, but to defective minor details, the remedy for which is no doubt already at hand. Suffice it to say that words were distinctly transmitted to and fro, whilst the train was running at a speed of not less than 25 miles an hour!

THE TRANSMISSION OF POWER BY ELECTRICITY.

MR. ROBERT LUCE, A.M., has contributed a long paper on this subject to *Van Nostrand's Engineering Magazine*, from which we abstract the following:—

To discuss intelligently the methods by which energy, *alias* power, is usually transformed into electricity, it will be necessary to go back to the beginnings of electrical science.

From the discoveries of four men—Oersted, Arago, Ampère, and Faraday—has been developed the science of dynamical electricity. Just as geometry was constructed from axioms, self-evident truths, so this science has been built up from certain truths which may be termed electrical axioms, and it cannot be too forcibly impressed upon the reader's mind that these electrical axioms must be thoroughly understood, with all their significance and in all their bearings, before proceeding further. They are known from the name of their formulator as Ampère's laws. From these it is easy to see how motion will produce currents of electricity, and, *vice versâ*, how currents of electricity will produce motion. The elaborate dynamo-electric machines of to-day are worked on these very principles according as they are used respectively as generators or motors; yet, strange to say, nearly half a century passed before any one thought of what they had in common.

Under the head of the transmission of electricity it will be enough for the present to state what may seem a truism, viz., that a considerable current of electricity can be transmitted over a wire to a long distance. Let us now consider the history and principles of those machines that convert the electricity into power.

Among the many experiments which Faraday made in electrical science, after the discoveries of Ampère and his contemporaries, were some to ascertain the effects of currents upon one another and upon passive conductors. As we have seen, Ampère discovered the attractive and repulsive powers of currents, and no doubt was the first actually to produce motion by means of electricity, but Faraday was the first to make any extended experiments in this

direction, and he should have the credit of first bringing the motory powers of electricity into prominence. It has been claimed that the first machine actually moved by "electro-magnetism," as it used to be called, was invented by Professor Henry, of Albany, New York, consisting of an oscillating beam surrounded by a conductor of insulated wire and two stationary magnets. The proofs advanced in support of this claim are not positive. However that may be, it seems to be well established that the first rotary motion by means of an electric current was the production of an American, one Thomas Davenport, of Brandon, Vermont. His claim to this honour has not of late years been pushed or even published, and the man and his invention have been forgotten. Still there is a positive evidence that in 1834 he invented and exhibited an electro-magnetic engine. If any European produced a rotary motion in this way before this date, I have been unable to ascertain it. I beg leave here to put in a plea for Mr. Davenport, and to claim for America the honour of first utilising the force which is destined to revolutionise the mechanical systems of the world. The originality of this plea may be judged when we read among the writings of the celebrated physicist, Ganot, that "M. Jacobi, of St. Petersburg, was the first to construct an electro-magnetic machine, with which, in 1838, he moved on the Neva a small boat containing twelve persons." By reference to the Boston papers of the year 1835, it will be seen that in that year Davenport exhibited in Boston an electro-magnetic engine running on a small circular railway. Three years before Jacobi's boat swam the waters of the Neva, Davenport's engine, the result of American application, of American perseverance, of American intelligence, ran along the rails, giving America the honour of being the first to harness the giant force and compel it to do her bidding. To the combined minds of England, Italy and Denmark, we owe the discovery of "electricity by power," but to America, to Professor Henry and Thomas Davenport, we owe the discovery of "power by electricity."

After Davenport's discoveries, Prof. Page, of Washington, took up the subject and made many practical inventions. Among them was a large and efficient electro-magnetic engine of sufficient power to propel a railway car with considerable velocity. It would be interesting to touch upon some of the others, but they are hardly relevant. I would only mention a fact little known at the present day, viz., that Prof. Page has shown very strong evidence to prove that the honour of inventing the Ruhmkorff coil should be given to him. Here again America was possibly several years ahead of Europe. My authority for this, and for the statements about Davenport's invention, is Silliman's *Journal of Science and Arts*. A pamphlet on "The History of Davenport's Invention of the Application of Electro-Magnetism to Machinery," gives much information on the subject.

For many years the two sciences of magneto-electricity and electro-magnetism were growing up, developing, side by side. But at last some one saw what they had in common, united them, and, lo! a new science sprang into being. The exact time of the origin of the idea of using the electricity generated by power to produce power in turn, and the identity of the man who conceived it are alike uncertain. J. Chrétien states that the first attempt to transmit motive power by electricity was made in 1873, at the Vienna Exposition, by H. Fontaine. Certainly in 1876 at Philadelphia, and in 1878 at Paris, the experiment was made. It is enough for us that, to-day, the electrical transmission of power is an accomplished fact.

It has now been shown, first, that power can be made to generate an electric current; second, that an electric current can flow to a considerable distance; third, that an electric current can generate considerable power; in other words, that electric transmission is possible. The question now comes up, is it practicable? To answer this we must first ascertain two things: (1) How much power can be advantageously employed? and (2) How much of it can be reclaimed?

As to how much power can be reclaimed, there has also been much experiment, and the scientists do not altogether agree; but as nearly as I can judge from the various results obtained, I am warranted in setting the practical efficiency of a dynamo at about 85 per cent. That is to say, about 15 per cent. of the power expended on a dynamo will be lost in the process of conversion into electricity.

It might be inferred that if an exactly similar dynamo were used as a motor, its efficiency would be 85 per cent., and, therefore, leaving out of account the transmission of the electricity, 85 per cent. of 85 per cent. might be reclaimed. But here another factor comes in, viz., the induction of counter-currents in the motor, which is the practical hindrance to reclaiming so much as this. As has been shown, when a current is conducted into the coils of the motor, the armature will begin to revolve. Its rotation is exactly the same as it would be if the motive power came from a pulley belt attached to its wheel. The result is that currents are induced in the coils. But these currents are directly the opposite of those which are produced by the dynamo and which are giving the armature of the motor motion. These counter currents lessen the effect of the direct current from the dynamo proportionally, and the faster the revolution the stronger the counter-currents. Then, since the strength of the current from the dynamo is greatest when the motor is at rest, it will be readily seen that when the most work is obtained from the motor, its armature is revolving at one-half the speed of that of the armature of the dynamo. Hence, if two equal machines are arranged for the transmission of power, the amount of work reclaimable from the second machine will be in general 50 per cent. of that employed on the first. This, of course, leaves out of account friction and the efficiency of the two machines. If we allow 10 per cent. loss for the former, and 25 for the latter, we have left but 65; and as 50 per cent. of this is lost by the production of counter-currents, we finally secure from the motor but between 30 and 35 per cent. of the power originally employed. Even if the loss be as great as this, the transmission would be not only possible but very profitable.

The question of the amount of power reclaimable was the subject of much discussion in connection with experiments made at the Electrical Exhibition in Munich, in the fall of 1882, by M. Marcel Deprez. He succeeded in transmitting power from the village of Weisbach, a distance of 57 kilometres, over an ordinary telegraph wire. The insulation was good, but differed in nothing from that usually employed on all telegraph lines. A heavy rain fell during almost the whole duration of the experiments. In the first of these there was immediately obtained at Munich a speed of 1,500 revolutions per second, the generating machine moving at the rate of 2,200. "The two machines being identical," said Deprez, "the proportion of the work recovered at Munich to the work expended at Munich was, setting aside passive resistance of every kind, $= \frac{1,500}{2,200}$, or more than 60 per cent." These figures were subsequently sharply criticised in the *Electrical Review*, and Deprez was finally forced to admit that while the electrical result, as he termed it, varied from 50 to beyond 60 per cent., the industrial result varied only from 25 to more than 35, according as the generator turned at 1,600 or 2,000 revolutions. As perfect insulation was supposed, and other inacceptable hypotheses were assumed, the official report of 38·9 per cent. reclaimed can only be accepted under the most express reserve. The real amount of industrial work reclaimed was probably about 20 per cent. Taking into consideration the unfavourable circumstances, the fact that ordinary telegraph wire with ordinary insulation was used, and that the dynamos were not suitable for the experiment, it will be seen that the results do not disprove the conclusion that for practical purposes between 30 and 35 per cent. can be reclaimed, but rather go to substantiate it.

The most important use to which the principle of electric transmission of power is at present being put, is the running of railway cars. It was only a little over five years ago that the first electric railway was built—an experimental one—in Germany, and to-day there are many in that country where their practical success has been first demonstrated. In France and England they are fast becoming popular, and it seems strange that those in America are yet all of an experimental nature. In this branch of electrical science, at least, America is far from foremost.

The advantages of electricity over steam for railway purposes are many and great. In the first place the bulky locomotive is done away with, as the motor can be placed either under the car or on trucks by itself, in either case great weight and room being saved. The machinery for converting the coal into the power, or rather extracting the power from the coal, is not portable, but stationary, and can be placed in the most convenient spot, even water-power thus being made available.

Far steeper grades can be surmounted on an electric than on a steam railway. Several carriages, each equipped with a motor, can be joined to one tram, which will give a distribution of motive power sufficient to overcome great inclines, or electro-magnets can be attached to the car directly over the rails, so that when they are thrown into connection with the current the car is pulled, as it were, toward the rails, and the adhesive power of the wheels is increased wonderfully. In this way the adhesive power of a 10-ton electric locomotive becomes greater than that of a 40-ton steam locomotive. Inclines of 2,000 feet to the mile have been surmounted with the electric locomotive.

As to speed, it is impossible to give the limit which can be reached on electric railways, because those so far constructed are on streets or in localities where very rapid transit is not possible or desirable. On the very first one built a rate of seven miles per hour was customary. On the Berlin railway, opened in 1881, the greatest speed reached was at the rate of 18 miles per hour. More was possible, but the police authorities refused to permit more than 9 miles per hour. Up to August, 1882, there had been no breakdown on this road, but Dr. Siemens acknowledged that in the winter the loss of power was more than quarter of the power supplied, a fact which indicates one of the barriers to complete success in electrical railroading. On the Siemens railway, at the Paris Exhibition of September, 1881, a distance of over 1,600 feet was traversed in a minute, which is at the rate of nearly twenty miles per hour. There is every probability that electric locomotives can be run faster than any steam locomotive now in use.

Economy is a most vital question. The electric locomotive can be built a great deal more cheaply than the steam locomotive. No coal has to be carried, and the coal used can be of a cheaper quality. Huge repairing shops are wholly unnecessary. One man can run the electric locomotive; electric brakes† are by far the

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* This paragraph is extremely misleading, for no excessive speeds can be looked for in this direction, a fact which Mr. Luce can easily understand by reference to the paper on "Electrical Locomotion," by the late Robert Sabine, published in the ELECTRICAL REVIEW for June 16th, 1883.—EDS. ELEC. REV.

† This, again, is a fallacy.—EDS. ELEC. REV.

strongest and most trustworthy. It is claimed that an electric car can be run on street railroads at one-fourth the cost of a horse car. This problem is wonderfully simplified by the utilisation of some kind of secondary batteries, or accumulators, as they are called. By their help the electricity can be manufactured at any time and place convenient, and stored until it is required to be used. This, it is evident, will do away with the intricate and cumbrous paraphernalia of posts, wires, transversers, &c. Prof. W. E. Ayrton said, in March, 1882, that using only a single cell of Faure's accumulator, about 300 lbs. dead weight, contains all the energy and all the machinery necessary for over ten miles' run of a tram car with 46 passengers. In spite of the temporary character of the arrangement at the time in use at Leytonstone, the total weight of the Faure cells, dynamos, and gearing combined, was only one and a-half ton, or one-third the weight of the detached steam or compressed air engine commonly used for tram cars. In a ton of the cells, as at present constructed, there is about 50 miles' run of a tram car containing 46 passengers. Electric storage of energy, moreover, makes us nearly independent of accidents to the engine or dynamo machine, or irregularities in their working, while the process results in no considerable loss of power.

Although the application of electricity to the running of railway cars is almost the only direction in which the art of transmitting power by the electric current has made any practical advancement, in many other lines experiments have been made which show the vast possibilities of this art. A few instances may be interesting. Professors Thomson and Houston succeeded in transmitting considerable power through a wire only 0·004 inch in diameter. Important experiments upon ploughing by electricity were made in France early in 1879, which showed that for this purpose electricity can replace steam with advantage and economy. Since that time great progress has been made in pumping, pile-driving, punching, sawing, sewing, embroidering, weaving, printing, &c., by electricity. In short, enough has been done to show that methods, not possibilities, are now the things to be considered.

The possible applications of the principle of the electrical transmission of power are almost numberless. All the uses to which the energies of steam, water, or compressed air are now turned may be subserved as well by electricity, and this may be generated in places far more convenient than those now usually employed for the conversion into active energy of any of the forces latent in nature. We shall, I believe, at no distant date, have great central stations, possibly situated at the bottom of coal pits,* where enormous steam engines will drive many electric machines. We shall have wires laid along every street, the electricity tapped into every house, and the quantity of electricity used in each house registered as gas is at present. The storage battery will fill a place corresponding to the gasometer in the gas system, making the current steady, rendering the consumer independent of the irregular action or stoppages of the dynamos of the central station, and enabling the use of dynamos of the highest tension. The electricity will be passed through little electric machines to drive machinery, to produce ventilation, to replace stoves, and to work all sorts of apparatus, as well as to give everybody an electric light. Solar heat will be used to run the dynamos in the cloudless regions. Everywhere the powers of the tides and such waterfalls as Niagara are to be utilised. Is not a millennium to be anticipated when the water power of a country shall be available at every door?

Electrical transmission has the unparalled advantage of being superior to the obstacle presented by distance. Then, again, it operates its miracles in perfect silence and repose. No force appears in the conductor such as appears in shafting, in pipes with compressed air or water, in endless chains or belts; and, in case of powerful currents, insulation is easy. The conductor is inert, and can be bent or shifted in any way whilst transmitting many horse-power, provided, of course, its continuity be not interrupted. It can be carried round the sharpest corners, through the most private rooms, into places where no other transmitter of power could possibly be taken. There is nothing to burst or to give way. In short, such a method of transmission would be the acme of dynamical science.

The power which is daily wasted in a hundred ways—enormous, immeasurable as it is, will some day do its share toward the support and the advancement of the human race. Steam, which in the last century has conferred so many benefits on the world, will give way before electricity. The dynamo will replace the steam engine. This prediction seems wild and visionary, yet when steam was first thought of as an available force, its advocates were considered, just as the advocates of dynamical electricity to-day are considered—mere enthusiasts. But public opinion never stops the march of intellect. After it had proved the powers of steam to be enormous, genius never halted, but straightway went on anticipating still more wonderful discoveries in the realms of electricity.

The principle of the transmission of power by electricity fast approaches its realisation. We are, in truth, just entering upon a wonderful age.

* We are really afraid that Mr. Luce's enthusiasm carries him too far. Our daily papers are already too much encumbered with the ghastly details of frequent pit accidents. What would be the result if the above suggestion were carried out?—EDS. ELEC. REV.

LEGAL.

In re the Irwell India Rubber and Gutta Percha Works, Limited. (Before Vice-Chancellor Bacon.) This was a creditor's petition to wind up the company, which was formed in 1879. Mr. Millar, Q.C., and Mr. Swinfen Eady appeared for the petitioner. Mr. Marten, Q.C., and Mr. E. Ford, for three-fourths of the creditors, asked for the carriage of the order, and this application was supported by Mr. Alexander and Mr. Davenport, for contributories, and by Mr. Theobald, for two creditors. Mr. Ingle Joyce, for the company, did not oppose the petition. The Vice-Chancellor said every one was agreed that there must be a winding up; but then arose that most interesting of all questions—Who was to have the carriage of the order? Although not a word in the petition was challenged, or disputed, he was asked to take away the conduct of the proceedings from the man who came first and to hand it over to some one else. He saw no reason for doing so, and, therefore, the usual winding up order must be made on this petition.

NOTES.

Electric Lighting in India.—The Government of Mysore has granted to the Consolidated Electric Company, Limited, manufacturers of the B. T. K. storage system, the sole right for 55 years of lighting by electricity in the Province of Mysore. The concession permits the company to acquire lands for the necessary works, and to put down plant under or over any public roads or thoroughfares. The Government admits all plant and materials required for the business of the company free of taxes or duties of any description. The principal towns in the Province of Mysore are Bangalore, Mysore, Chitteldroog, Seringapatam, Bednore and Shemocca. The electric light has been introduced on a very small scale at Mysore, and we trust that the inhabitants of this place will be more liberal in their patronage of incandescence lamps than were the townsmen of Colchester. If not we may well ask of what value is such a concession?

Lighting an Asylum by Electricity. — The Corporation of Exeter is inviting schemes and specifications for lighting by electricity an asylum now in course of erection. The asylum will be constructed to accommodate at present 300 patients, with provision for extension. Particulars and the ground plan can be seen at the office of the architect, Mr. R. S. Wilkinson, 14, Furnival's Inn, London, or Post Office Chambers, Queen Street, Exeter. Tenders for (*a*) the first cost of installation, and (*b*) for maintaining and working the scheme recommended for a term of seven years at a fixed sum per annum, but all tenders for installation only must state the probable annual cost of maintenance and working. Schemes and specifications must be accompanied by a tender to carry out the work. Tenders to be sent in by May 1st.

The Electric Light in Houses.—A Glasgow contemporary writes:—Although several electric light companies have come to commercial grief of late, the fittest will survive; and an idea of the possibilities of the illuminant of the future is afforded in the description given by a recent visitant to the house, near Bromley, in Kent, of Mr. Swan, the most prominent pioneer of the system of electric lighting. No matches or candles, he says, seem to be required therein. Thus a person can light his way upstairs or about the house late at night by switches or press-buttons in the wall, which light up a lamp in advance of him and extinguish those behind. In this respect he may be said to travel with his light, or, at least, call it into existence as he needs it. In the same way one can light up his bedroom before entering it, and darken it on leaving, by simply pressing a key at the door. Or, again, one can switch the light from his toilet table to his desk or sofa, and in one of the bed-rooms, reserved for invalids, there is a lamp just over the pillow, which the patient may employ to read at night, and extinguish by the feeblest effort. Every part of Mr. Swan's house is lighted by electricity, from the nursery above, where the lamps are hung from the ceiling out of the children's reach, to the coal cellars below.

The Queen and Electric Lighting.—Mr. W. H. Massey, of Twyford, Berks, under whose supervision the electric lighting experiments at Windsor Castle and at Buckingham Palace were successfully carried out during the last two seasons, has been appointed to the position of mechanical and electric light engineer to the Queen.

Electric Light in Shipping Houses.—Six arc lamps have recently been introduced in the shipping warehouse of Messrs. A. and S. Henry, Bradford, and the light has been found to be of great value. In the pattern room, where the most delicate shades of colour have to be matched, it is quite equal to day light, and in the overlooking department, in which the different pieces of stuff goods are examined for flaws, &c., it is equally serviceable. Work of this kind, it may be stated, had formerly to be discontinued when daylight had gone, gas light being unsuitable. A resistance box is fixed beside each lamp to permit of its being turned off without disturbing the circuit. The motive power is supplied by a 6 horse-power steam engine, which draws its steam from the main boiler. Messrs. Paterson and Cooper's Phœnix dynamo is in use. Electric lighting for similar purposes has been adopted by Messrs. Kessler & Co., shippers, Bradford.

Domestic Electric Lighting.—An interesting installation of electric lighting has just been carried out at the private residence of Mr. Frederick Illingworth, Bradford. Three 20-candle Swan lamps have been fixed in the library, five in the drawing-room, and six in the dining-room. These lamps are suspended from the existing chandeliers, and an arc lamp of 1,000 candles hangs in the lobby. A series of switches enables the light to be transferred to whichever room is in use at the moment, or, if necessary, all the rooms may be illuminated at one time. A gas engine supplies the motive power at a cost of something less than a penny per hour. The dynamo was manufactured by the firm which has carried out the work—Messrs. J. Roper & Co.

The Experiments on H.M.S. "Colossus."—The *Mechanical World* is assured, "on authority," that the general result of the recent experiments conducted on board H.M.S. *Colossus*, as to incandescent electric lighting *versus* oil lamps, is considered favourable to the electric system, as regards both cost and efficiency. Details are shortly to be published.

The Simplex Electric Light and Plant Company, Limited.—This company held its first annual meeting on Friday, the 27th of February. The chairman spoke hopefully of the prospects of the company, and said it was now in a position to undertake electric light installations of incandescent or arc lamps of its own manufacture. A considerable amount of work had been executed successfully, amongst others for the following:—Messrs. Ermen and Roby, Patricroft; Messrs. Robertshaw and Sons, Bradford, Yorks; Messrs. Sutcliffe and Whiteley, Bradford; Messrs. S. and T. L. Ormerod, Haslingden. The company is at present laying down an installation at Messrs. Chas. Cannell and Co.'s, New Oaks Colliery, near Barnsley.

Telephones in Paris.—The Société Générale des Telephones of Paris has extended its facilities for the despatch and reception of telegraphic messages. This extension has been in public use since February 15th. On paying a supplementary rental of 50 francs a year, and the deposit of a sum intended to cover the amount of the telegraph tax for which the company is responsible to the State, the subscriber can transmit and receive telegrams. The text of the despatch is necessarily in French, and must be preceded by the word "Telephone" to prevent its delivery by the ordinary method. The company transmit the message by telephone, confirming the wording by the earliest post.

Underground Telephone Wires.—At the last meeting of the Edinburgh Town Council permission was given the National Telephone Company to lay underground wires from St. Andrew Square to Broughton Market, and a branch line from North Saint Andrew Street to North Saint David Street, on payment of one penny per yard as rent for use and for damage to streets. We understand that the National Telephone Company contemplates a further extension of its Edinburgh underground system.

Telephonic and Telegraphic Communication.—The Associated Chambers of Commerce last week considered a resolution suggested by the Hull Chamber of Commerce in favour of the material reduction of the present rate charged for telephonic communication by the Post Office exchanges, and private wires supplied by them, and it was agreed that a representation should be made to the Postmaster General on the subject. In confirming the resolution of last year on the subject of foreign and colonial telegraphic charges, the Executive Council was, on the suggestion of the Hull Chamber, requested to take measures to have the views of the associated chambers represented at the approaching International Telegraph Conference.

Telephone Right of Way in Germany.—It is reported that the local authorities of Neu-Isenberg, Spendlingen, and Langen oppose the passage over their territory of the telephone wires for connecting Frankfort and Mannheim, and that the whole question as to this "right of way" is now before the German law courts.

The Telephone in the States.—From figures collected by Commissioner Butterworth, of the U.S. Patent Office, it appears that the number of telephone exchanges in the United States on January 1st, 1884, was 906; number of miles of wire, 85,896; number of employés (exclusively of day labourers), 47,062; number of subscribers, 123,625. From these figures and others of like character the Commissioner argues that the multiplication of inventions has increased instead of reduced the demand for labour.

The Bell Patents in Canada.—It is stated that the Bell Telephone Company intends to contest the "final" decision of the Minister of Agriculture, invalidating its Canadian patent.

The Telephone in Vienna.—By the end of June last the Vienna telephone lines attained a length of 175 kilometres (108 miles). The total length of wire in the cables was 1,300 kilometres (807 miles), and in underground lines, of silicon bronze wire 1 mm. in diameter, 1,683 kilometres (1,045 miles). The number of subscribers was 708, and that of direct connections, 120. In the month of June nearly 52,000 messages were sent by the subscribers, making 1,750 a day. The two central offices are served by 42 girls.

The London Telephonic System.—The London correspondent of the *Bradford Observer* writes:—"An innovation has recently been introduced into the telephonic system as affecting London, which, when once it becomes generally known and acted upon, cannot fail to materially extend its usefulness. The United Telephone Company used up to a week or two since to close its operations at seven in the evening, but now on some of its West End circuits the business is kept open throughout the night. If the experiment succeeds all the offices are likely to be similarly made available to the thousands of subscribers now on the books."

Telephonic Charges.—At a meeting of the Hull Chamber of Commerce, held on Monday last, a committee was appointed to prepare a memorial to be presented to the Government at the proper time, praying for a reduction of the present rates for telephonic intercommunication, and for private wires. Hull is one of the few towns where the telephone exchange is in the hands of the Post Office.

Telegraphic Communication with Light Vessels.—In the House of Commons on 26th ult., Mr. T. Lea asked the Secretary of the Board of Trade whether telegraphic communication had been established between the *Sunk* lightship and the shore; and whether the experience of its working was so satisfactory as to induce its extension to other lightships or to lighthouses. Mr. J. Holms: The experiment of connecting the *Sunk* lightship with the shore by electric cable commenced last December, and is to continue for twelve months. If at the end of that period it has worked and is working satisfactorily, the Trinity House are to take over the cable from the Telegraph Construction and Maintenance Company, who are not to be paid before the cable is taken over. It will be well to await the result of the first twelve months' working before considering the question of extending the experiment to other stations.

Telegraphists in the Soudan.—A further call was made on Monday upon the 24th Middlesex Rifle Volunteers, who have been requested to furnish another detachment of 15 field telegraphists for service with the Nile expedition. The men will be required to join at Aldershot on Monday next. Instructions have been received for another section of the Telegraph Battalion Royal Engineers to prepare for service in the Eastern Soudan.

Cable Repair.—The Compagnie Francaise du Télégraphe de Paris à New York informs us that its main cable has been repaired, and that communication with the United States and Canada is now restored.

Australian Telegraphs.—The Hon. John C. Bray, ex-Premier of South Australia, in the course of his address to the members of the Greenock Chamber of Commerce last Saturday, said:—"With regard to South Australia, I may say that she has done one great thing, and which has been acknowledged by all the colonies as being a great improvement, that is, constructed a line of telegraph from the southernmost to the northernmost parts of Australia, and which has brought us into communication with the submarine cables of England, and into daily communication with all the civilised world. At the present time we have all the daily papers receiving telegrams from England, and I need hardly tell you that if any of these telegrams go amissing at any time there are great complaints heard from one end of the colonies to the other. The telegraph lines belong to the Government. The cost of a telegraphic message from Australia to Britain is 10s. 8d. a word for ordinary messages, but that of course is not the rate for press messages; they come for less." He believed that there was a prospect of an arrangement by which the cost would be reduced.

Grand Prize in the Mathematical Sciences.—Question proposed for the year 1884, but postponed to 1886. The Paris Academy of Sciences still proposes for competition for the year 1886 the following problem: "The improvement, in some important point, of the theory of the application of electricity to the transmission of work." The prize will consist of a medal of the value of 3,000 francs. The memoirs must be sent to the secretary's office before the 1st June, 1886. They must bear a motto or device which is also marked on a sealed envelope containing the name and address of the author. This envelope will be opened only if the memoir to which it belongs receives the prize.

Baltimore Tramcars to be run by Electricity.—Preparations are being made to run the Hampden Street cars from the Union car stables, on Huntingdon Avenue, to Hampden, Baltimore County, by electricity. The "Daft" system is to be used. A 75-horse-power engine to drive a 50-horse-power dynamo will be located at the Huntingdon Avenue stables. It is expected that the system will be in practical working order by the middle of this month.

Chicago Wires.—Exchanges state that rapid progress is being made in Chicago in getting rid of aerial telegraph and telephone wires, and that the work of placing the wires under the ground is going forward without attracting attention or disturbing business. There are now 718 miles of underground wires in the city, and the *Inter-Ocean* predicts that in a year or two aerial wires in Chicago will be as much a thing of the past as the erection of frame buildings within the city limits.

Underground Fire-Alarm Wires.—The Washington *Critic* says the recent fire in the office of the *Star* of that city shows the importance and superiority of good underground cables. The cable laid by the Underground Cable Company, more than a year ago, has been used on one of the Fire Department circuits, and proved to be better than the overhead wires, and they have not failed in one instance to work promptly.

International Inventions Exhibition.—The literature of the Inventions Exhibition will differ considerably from that of the two former exhibitions. No handbooks are to be prepared, but the prefaces to the various groups in the catalogue are intended to a large extent to supply their places. The catalogue will contain twenty-three prefaces, written by the first authorities of the day upon the particular subjects entrusted to them. Amongst these prefaces will be the following:—Group IV. Prime Movers and Means of Distributing their Power, Mr. Wm. Anderson, M.Inst. C.E. Group XIII. Electricity, Prof. Oliver Lodge, D.Sc. Group XV. Gas and other Illuminants, Mr. A. Vernon Harcourt, M.A. Group XXI. India Rubber and Gutta Percha, &c., Mr. W. Y. Dent, F.C.S., F.I.C.

Progress of Electricity.—*Il Giorno e Notte* is responsible for the following:—"In America there have recently been so many cases of premature interment that it is proposed to establish telephonic communication between the principal exchanges and the coffins of doubtful cases."

Originality in Journalism.—The *Cablegraph* is so venerable that it may be excused a little garrulous preaching now and then, but when our contemporary talks of American and other journals using its notes it should be at least careful that the alleged notes really belong to it. Oddly enough this sensitive journal, which closes its leaves at a touch, opens them readily to receive what is sent without troubling itself as to quality or proprietorship. On the 28th ult., for example, is a description of a lamp copied almost verbatim from the *Electrical Review* of the week before, and a description of some engines which we have certainly read once or twice before, but which also appears as if original.—*Mechanical World.*

Monument to the Late Sir William Siemens, F.R.S.—A handsome monument has recently been erected in Kensal Green Cemetery over the grave of the late Sir Wm. Siemens, F.R.S. It consists of a cross of red Aberdeen granite, in which is inserted a medallion of the deceased gentleman in Greek marble. The monument was erected by Mr. A. Bruce Joy, sculptor, of Burlington Gardens, London, W., and the friends of the deceased gentleman have expressed their highest appreciation of Mr. Joy's admirable portrait.

The Blackpool Electric Tramway Company.—The *Mechanical World* states that, determined to be ready for the aproaching season, the directors of the Blackpool Electric Tramway Company have engaged a large body of men to lay the lines upon the promenade.

Professorial Appointment.—We are pleased to learn that Professor Silvanus Thompson is about to leave the University College, Bristol, for some appointment in connection with the City and Guilds of London Institute. We shall probably be able to give our readers some further information with regard to this appointment next week.

Messrs. Blakey, Emmott and Co.'s Works.—We have recently visited the new works of Messrs. Blakey, Emmott & Co., the well-known electrical engineers of Halifax. The premises are very extensive, and, with the exception of those where cables are made, are, we believe, the largest of the kind in the country. They cover an area of about 2,500 square yards, and the main building is six stories high. The cabinet works, where all the cases, &c., used in the work are made, are entirely detached from the large building on account of the immunity from risk of fire. About 20 employés are at work in this department alone, where is to be seen the most modern wood-working machinery. The ground floor of the principal building is occupied by the heavy machinery, such as shaping, planing, boring machines, &c., and we saw a considerable number of dynamo machines in progress, amongst them being that under the Joel patent. A considerable number of small lathes and special tools are made here also. The second floor is occupied by the magneto bell and ordinary electrical bell department. This firm does, as is well known, a considerable portion of the magneto bell work in this country, and the quality of the work leaves nothing to be desired, every part which can be made by machinery is so made, and no expense has been spared to make the machinery as perfect as possible. The third floor is occupied by the stores, packing-room and warehouse, where all the instruments are brought when completed, and most thoroughly examined before being allowed to leave the place. The fourth floor is occupied by the general telegraph work, &c., and is like the other departments, fitted with the most perfect machinery, and everything is in excellent order. We saw a large number of instruments, such as S. N. block instruments, repeaters, Fletcher's watchman's tell tales, recording clocks, &c., in progress; also Edmondson's patent calculating machine, of which we hope to give a detailed description at an early date. The next floor is devoted to the wire covering, and the winding of the various coils, &c., and the top storey contains the screw-making machinery. Separate, again, from the works, we were shown the testing-room, where the resistance coils, &c., are completed. The whole of the machinery is driven by a fine horizontal condensing engine of about 80-H.P. From what we saw there is reason to believe that this firm is particularly well laid out for the best class of work.

The Society of Telegraph Engineers and Electricians.—The next meeting will be held at the Institution of Civil Engineers, 25, Great George Street, Westminster, on Thursday, March 12th, 1885, when the following papers will be read:—"On constant electromotive force in an electric light circuit," by Sir David Salomons, Bart., member. "Electrical definitions, nomenclature and notation," by Andrew Jamieson, F.R.S.E., member.

Conference on Patent Law.—The council of the Society of Arts announce that they have determined to hold, during the time the International Inventions Exhibition is open, a Conference on Patent Law. The subjects for discussion will include questions on International Patent Law and also the working of the new Patent Act.

Overhead Wires.—The Paving and General Purposes Committee of the St. Saviour's Board of Works reported at the recent meeting of the board that they had considered the circular letters from the vestries of St. James's, Westminster, and St. Marylebone, on the subject of telegraph and telephone wires. The committee concurred with the vestries as to the desirability of the question being dealt with by a select committee, but was of opinion that overhead wires should not be permitted under any circumstances, and that all such wires should be laid underground, the consent of the vestries and district boards being first obtained. The report was adopted.

Condensing Vessels at Suakin.—The authorities have decided upon having three other condensing vessels in addition to the *Calabria* at Suakin, and have accordingly, as we mentioned last week, engaged the *Kangaroo*, belonging to the Telegraph Construction and Maintenance Company, now on her way home from Madeira; the *Cyphrenes* at Liverpool, and the *International* cable-laying ship from the Silvertown Works. Telegraph ships are preferred on account of their tanks, which are utilised to carry fresh water. The ss. *International* is being fitted out in the Victoria Docks. Her cable tanks will, we believe, contain considerably over 100,000 gallons of water. She is now having several large boilers put in to supply the condensers with steam, as well as for driving the large pumps requisite for furnishing the great quantity of circulating water which is necessary for condensation, owing to the high temperature of the water in the Red Sea.

An American Electric Railway.—A number of electricians and capitalists met in New York, at the office of Mr. Cyrus W. Field, last month, and completed the subscription to the stock of the new American Electric Railway Company. Exchanges state that a sufficient amount of money has been raised to lay extra rails on the Second Avenue elevated railroad structure, and to make a thorough test of the electric motor. The corporators and trustees for the current year are Cyrus W. Field, Edward H. Johnson, Frederick F. Thompson, Stephen D. Field, Robert E. Deyo, Edward N. Dickerson, jun., Charles Batchelor, Francis R. Upton, and Daniel A. Lindley. The capital stock is $1,000,000, and the company's purpose is to build, own, sell or let locomotive engines, cars, rolling stock generally, and railway machinery.

The Lalande-Chaperon Battery.—A correspondent writes:—I have read Mr. Stanley Currie's letter in last week's issue of the ELECTRICAL REVIEW, and as he so kindly offers to give further information respecting the battery, I shall be glad if he will say if they are in the market yet, and if so, where they may be purchased, as for a long time past I have been trying to obtain them, but cannot.

The British Association.—It is announced that Professor Bonney will resign his post as secretary of the British Association after the Aberdeen meeting. Professor Bonney takes this step mainly on account of the inroads which the work of the association makes upon his time.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

South African Brush Electric Light and Power Company, Limited.—The annual return of this company, made up to the 18th ult., was filed on the 24th ult. The nominal capital is £100,000 in £5 shares. 19,474 shares have been taken up, and £2 10s. per share has been called thereon. The calls paid amount to £49,114, and unpaid to £886. Upon 526 shares forfeited £429 has been paid. At a meeting of the company, held on the 4th ult., it was resolved that the company be wound up voluntarily, and Mr. Thos. Joice Seel, the secretary, was appointed liquidator.

Union Electric Light and Power Company, Limited.—A meeting of this company was held on the 23rd ult., at which an account was given of the manner in which the winding up of the company has been conducted and its property disposed of. The notification of the meeting was duly filed on the 28th ult. in pursuance of the Companies' Acts.

Edison's Indian and Colonial Electric Company, Limited.—The registered office of this company is now situate at 4, Lothbury.

CITY NOTES, REPORTS, MEETINGS, &c.

South-Eastern Brush Electric Light and Power Company, Limited.

AN adjourned general meeting of this company was held at the offices, 68A, Cow Cross Street, E.C., on Friday last week, to receive the report of the committee of shareholders appointed at the meeting on December 22nd of last year. Mr. T. Fry, chairman of the company, presided, and there were about a dozen persons present besides the directors and officials.

The Chairman said: Gentlemen, this is an adjourned meeting for the purpose of receiving the report of the committee appointed at the ordinary general meeting in December last, and you will have to consider to-day and decide whether you will receive or reject that report. Now the date of this meeting has been fixed expressly to suit the convenience of the members of the committee. It does seem strange that notwithstanding that, not content to wait until an expression of opinion could be given by the shareholders, one member of the committee in conjunction with a shareholder has obtained signatures to a requisition calling upon the directors to convene an extraordinary general meeting for the purpose of considering a proposal to wind up at once, and to appoint two members of the committee as liquidators. Now that is a very nice little family arrangement, and probably would be very agreeable to those who have proposed it; but we directors have something to say to the shareholders before they appoint as liquidators gentlemen who have taken up such an attitude towards the company that we are suffering to a very serious extent. We hear that our business at Colchester is stopped from being extended owing to reports which have appeared in consequence of statements made by the committee; owing to those reports, we are told that our people will not go to the expense of laying on a supply of the electric light, because they do not know how long it will continue. ("Quite right.") Possibly it is quite right from your point of view; but we say we are suffering. It is for you gentlemen of the committee to give some reasons why your report should be received, and it is for you to propose its reception and adoption.

Mr. R. Braithwaite said he would not waste time by answering the chairman's remarks, to which, however, he could give a complete answer. He would simply move that the report of the committee of inquiry be adopted by the shareholders.

Mr. Combach seconded.

Mr. Stewart said it now became his duty to give some reasons for the course pursued by the committee and for the report issued to the shareholders. Calling attention to the arrangement made as between this company and the Consolidated Company, he charged the directors with having made a most improvident arrangement. Certainly they had been open and outspoken with regard to it in their reports. In one report they alluded to the arrangement by speaking of experiments which were carried on by the officials of this company, accepting high salaries—experiments which were for the benefit of the Consolidated Company. The amount of money and time spent in the experiments and appliances in the offices in Queen Victoria Street should have made the directors very careful in their arrangements with their officials. Many of the shareholders might be ignorant of the fact that in arranging for a company for the affair they allotted, out of 100,000 shares, no less than 60,000 to those who were in their own employ, retaining only 20,000 for this company, and 20,000 for the Provincial Brush Company. He therefore charged them with having made a most improvident arrangement, giving the power entirely into their employés' hands; to men whom they ought to have kept a tight hold upon they gave the entire control of the Consolidated Company. They committed the South-Eastern Company to find £10,000 of capital towards carrying on the business of the Consolidated Company, and took debentures which, he was advised, were of such a nature that they could not put them in force. They had not shown that that company, which had been formed more than a year, had made any profits whatever, and had refused absolutely to give any information in regard to its working. He found from the accounts that this company was bearing the brunt of the expense of testing the quality of the batteries at Colchester; in fact, the Colchester experiment originated in a measure with the view of testing the B.T.K. system. In addition to that £10,000, they committed this company to assisting in carrying on the operations of the Consolidated Company; and they went beyond that, they incurred an expense of £7,000 in establishing the lighting at Colchester, which was losing the company something like £1,000 a-year. Was it not time the shareholders put a stop to such extravagance? He wished to know the value of the asset set down as "by concessions, preliminary expenses, and expenditure in obtaining Provisional Orders, £14,711 4s. 7d." The concession from the Brush Company was, in a measure, worthless; they were now only entitled to 10 per cent. on business done by the parent company, for, without a doubt, the parent company, from its greater advantages, would be able to undersell them, and to take contracts which this company could not possibly carry out. Therefore that item was almost worthless. He looked upon the payments made for Provisional Orders as entirely lost. With regard to the Colchester plant, the only chance of realising anything on it would be to sell it to the Corporation at Colchester. But even if they valued it at the sum stated in the accounts, there was a loss of more than one-third of the capital. The only assets the company had were the plant at Colchester, the office furniture, the debentures of the Consolidated Company, and the 20,000 shares in the latter company, whose shares had been selling at from 1s. to 3s. each; so that the greater part of the capital was lost. He found, too, that the company had been worked most extravagantly. It was said for some time that the directors were most moderate in their fees; but he found that they took £2,300 in 1883-4. He heard from the chairman with great pleasure that they were not going to take any more fees; he hoped if the company went into liquidation they would carry out that, that they would consider they had had more than enough in the previous two years. He thought he had said enough to show that this company and the Provincial Company were kept on merely as milch cows to provide funds for the Consolidated Company.

Mr. Blewitt asked whether the report of Professor Forbes had been received, and if not, whether the directors or any of the officials had had any intimation of what was likely to be its nature.

The Chairman said a private and confidential report had been received by the directors of the Consolidated Company, to whom it was exceedingly satisfactory. That would be followed by a report which they would be allowed to publish, according to the terms of the agreement with Professor Forbes, on making a further payment to him. That report they would have very shortly.

Mr. Blewitt: Why is it, if £50 were paid by this company to Prof. Forbes, we do not receive the report in the first instance?

The Chairman: It was not this company. You are mistaken.

Admiral Sir Edward Englefield said that as a liquidator of the Metropolitan Brush Company he collected information useful not only to this company, but to any other company connected with the Brush system. Upon those grounds, without going into detail, he would urge the acceptance of the committee's report. What remained would be saved. Economy would be practised if the winding up of the voluntary liquidators were conducted on the same system as was observed in the winding up of the Metropolitan Brush. Nothing was to be expected from the Provisional Orders. The time might come when they might be successful, and the light be used all over the world, but it was not to be done with the material or by the companies at present in existence. He spoke from knowledge obtained as liquidator of the Metropolitan Brush Company, and also as chairman for two years of the Maxim-Weston Company.

Mr. Blewitt said if any justification were required for the action of the committee, it was amply supplied by the circular sent out by Mr. Fry and the speech which he had just made. He had urged two points against them. First he said they destroyed the concession and then endeavoured to sell it, that if they went to the Anglo-American Brush Company it would be to say, "We want to sell this concession to you, and if you won't buy it we are going to wind up." Why, they had the concession already for nothing! With reference to the Colchester concession, the directors held out a faint hope that it would be taken over by the Corporation or by a private company. Was it likely that either the Corporation or a private company would take it when the whole thing was proved to demonstration to be a failure. He thought the committee had exercised a most wise discretion in determining that the existence of the company should be terminated.

Mr. J. B. Braithwaite, jun., said with regard to the negotiations with the Anglo-American Brush Corporation, as one of the directors of that corporation he might say that the directors of this company, by their prudent and far-seeing policy, had already surrendered their concession, merely asking for 10 per cent. on business done. He had authority from the Brush board to say that they were not prepared to consider for a moment any proposition to give anything whatever for the assets of this company, which to his mind resolved themselves into liabilities and debts; therefore any suggestion of that sort from the chairman was merely an endeavour to keep the board in office a little longer until they had taken a few more fees, and until the manager and his son had taken a few more salaries.

The Chairman said he was obliged to Mr. Braithwaite for telling them that their concession was worth nothing.

Mr. Braithwaite: I did not say it was worth nothing, but that we already have it back again.

The Chairman, continuing, said he admired Mr. Braithwaite's candour. But how this would assist his friends on the committee he could not see. What was the reason alleged for going to the Brush Company by Mr. Stewart, Mr. Hewitt and others? They said, "Go to the Brush. The Midland and the Grest Western Companies have made arrangements. Go to the Brush." Now they were told it was useless to go to the Brush Company. But all this would be discussed further. The board would have to call another meeting in a few days to discuss the advisability of winding up. But he had something personal to say. Mr. Braithwaite had had the effrontery to say that the directors merely wished to keep the company going that they might continue taking their fees. They had not taken fees for 15 months, and had no intention of taking any. He asked Mr. Braithwaite to admit that he had made an unfounded charge.

Mr. Braithwaite said he would be quite happy to withdraw any portion of his remarks relating to directors' fees; but he could not withdraw the other portion. The fact of another call of 2s. 6d. having been made while that meeting was in process of being held was proof of what he had said. (Cries of "Plunder!")

The Chairman: I object strongly to this, and hope the Press will notice it. I object to the word "Plunder." There were liabilities that had to be met, and you were told on December 22nd the call would be made. Before taking the votes on the motion that the report of the committee be received and adopted, I may tell you I shall object to anyone voting who has

not paid that call. (Oh!) There are only in the room four other than ourselves who are entitled to vote.

The motion was then put, nearly all the shareholders present voting for it; the directors voted against it, and the Chairman declared the motion lost, on the ground that the majority of those present were not entitled to vote.

Mr. Blewitt demanded a poll.

The Chairman: You are not entitled to do so.

Mr. Blewitt: I have paid my call.

The Chairman: But you have not been two months on the register. (Cries of "Oh!")

Some discussion, which was not altogether intelligible and which was conducted with some warmth of feeling, then ensued with reference to certain proxies which it seemed had been lost in the office.

The Chairman repeated that the proceedings there could lead to nothing. The board would call another meeting within a week or ten days to consider a proposal to wind up, and then would be the time for them to discuss the matter.

Mr. Blewitt: And in the meantime you will be sending out that the committee's report is not carried.

Mr. R. Braithwaite said that was an adjourned meeting, and those who were entitled to vote at the commencement of the meeting were entitled to vote now.

The Chairman contended that he was perfectly within his right in the course he had pursued. He now moved, in order to complete the business of the meeting, that the directors' report and statement of accounts, presented on 22nd of December, be received and adopted.

Mr. Wapshare seconded, and the motion was put and declared carried, the voting having been the same as in the previous case.

Mr. Blewitt asked if the directors would receive payment of the calls at that moment.

The Chairman signified assent, although, he said, it was a most unusual course.

Mr. Blewitt: The object is to prevent you, by circular, telling the shareholders that the resolutions of the committee have been rejected and the resolution adopting the directors' report carried.

The Chairman: I pledge myself that we do nothing of the kind. We shall simply tell them that this meeting is mere waste of time. I pledge myself that we make no such use of the result. We had no thought of it.

Admiral Englefield: Is it the desire of the directors to keep the company going or to wind up?

The Chairman: Our only object is to make the best of it for the general body of the shareholders. We have no other interest.

The discussion gradually resolved itself into a conversational and informal character, and the Chairman shortly after vacated the chair.

Telegraph Construction and Maintenance Company, Limited.

THE twenty-first ordinary general meeting of this company was held at the offices, 38, Old Broad Street, E.C., on Tuesday, the Chairman, Sir Daniel Gooch, Bart., M.P., presiding. The directors' report, submitted to the meeting, was published in our columns last week.

Mr. Shuter, the manager, having read the notice convening the meeting, and the minutes of the previous meeting having been confirmed,

The Chairman moved, "That the report and accounts of the directors to December 31st, 1884, submitted to the meeting, be and the same are hereby received and adopted, and that a dividend of 36s. per share, in addition to 12s. per share as interim dividend paid on June 30th, 1884, be paid on all shares of the company for the year ending December 31st, 1884, and that such dividend be paid free of income tax." Before putting the resolution, he read a portion of the report showing the amount of work done during the year. Referring to the "Sunk" Lightship, he said that, as perhaps they remembered, it was a floating ship, and it had been the attempt of their officers to enable connection to be made between the floating ship and the shore for purposes of telegraphic communication. Unfortunately they had had more trouble than they expected, and at the present moment the thing was not a perfect success; but existing defects would be remedied, and they hoped soon to succeed. He was sure they would all be satisfied if they could carry out such a scheme, because it was very important to have the different light ships on the coast connected with telegraph cables. They could not promise success; but he knew their officers were doing their best, and they had to a certain extent succeeded. They had also connected the Fastnet Lighthouse with the shore, but the very bad weather prevented their properly landing the cable on the rock, and the consequence was that it chafed on the edge of the rock and became broken, but they did not think there was much risk, and when the weather permitted the cable would be made fast to the rock properly. Another work they were carrying out was the lighting by electricity of Paddington Station. That work, he hoped, would be completed in a couple of months. He confessed it had taken longer than he had expected, but it was the largest work of the kind in England, and probably the largest in the world. They thought it desirable, possessing as they did a provisional order for lighting St. James's parish, to get some knowledge of the cost before going into so large a matter, and therefore they were glad to have the opportunity of lighting the large station at Paddington, which would give them that experience which would enable them to judge how far they could economically and efficiently light large towns. The report stated that they were building a new ship to replace some that were not so young as they once were; that would be ready in the course of the summer. The Government had chartered two of their ships, the *Calabria* and the *Kangaroo*, for the purpose of going to the East to distil water for the troops; they were engaged for three months, or as much longer as the Government might require them. Those vessels were peculiarly well adapted for this purpose, the cable tanks enabling large bodies of water to be stored; perhaps such were the only ships afloat capable of doing that work efficiently.

Vice-Admiral Sir George H. Richards, managing director, seconded the motion for the adoption of the report and payment of a dividend.

Mr. Wakefield inquired what views the directors had formed as to the lighting at Paddington. Did they think it would answer? He knew one or two people who had lighted large establishments with electric light, and it did not seem to answer; it was very much more expensive than gas, and did not seem to have any particular advantage. But in large squares and places like the station at Paddington it would be a great advantage, and he would like to know whether the directors thought it would pay them.

A Shareholder asked if there were any orders in hand for cables.

The Chairman said the quantity of cable they had to make for the present half year was about 1,000 miles. With regard to the lighting at Paddington, he must say he did not believe it would pay them, except in the form that they would know exactly what the cost would be. As to its success, he had not the slightest doubt. They had worked the lights on the platform at Paddington for three or four years, and never had any difficulty, except in the first few months, when the engines did not work very well. He knew many cases where the electric light was used in private establishments, and it answered very well. In house lighting not only the cost was to be considered, but the freedom from destruction of decorations, pictures, books, and works of art. But he had no reason to suppose that the light would be more costly than gas; those who had tried it had not found it so, and he had no doubt that on a large scale it would answer still better.

A Shareholder asked a question as to the statement in the last report that the steamships were in efficient working order, and that in this year's report that one was to be thoroughly refitted and a new one built. He also argued that the accounts should show more fully the value of the property of the company in buildings, &c.

Mr. Abbott said he had learnt by 20 years' experience in connection with the company that it was better not to ask questions, but to trust to the responsibility of the chairman and the board. He was pleased to hear Lord Monck say at the recent meeting of the Anglo-American Telegraph Company that the only four Atlantic cables in working order were those belonging to the Anglo-American Company laid by the Telegraph Construction Company.

The Chairman said it would be absurd to give details in accounts of a trading concern such as this. With regard to the ships, it was quite true that they were in working order 12 months ago, but they were not so efficient as when they were built, and they could not then know how long they were likely to last.

The resolution was then put and carried unanimously.

The Chairman moved the re-election of Sir George Elliot and Mr. Philip Rawson as directors.

Mr. Campbell seconded, and the motion was agreed to.

The auditors, Mr. John Gane and Mr. James Clegg, were reappointed, and a vote of thanks was accorded to the chairman and directors, the proceedings thereupon terminating.

Australasian Electric Light, Power and Storage Company, Limited.

THE committee of shareholders appointed on December 30th last to confer with the directors of the Australasian Electric Light, Power, and Storage Company as to the past history and present prospects of the undertaking have issued their report, which will be submitted to a meeting of shareholders shortly. The committee finds, as a general result of their investigations, that the present unfortunate position of the company is mainly due to great prodigality in dealing with the company's capital in its early days; that, besides the enormous sum paid for the patent rights, other very large sums were at that time expended by the directors with a recklessness which the committee think unwarrantable under any circumstances, and which, in view of the collapse of public excitement about electric lighting, which occurred even before the shares in this company were allotted, appears to them almost inexplicable, and they then go on to deal with specific points of mismanagement. Sir Julius Vogel's mission to the antipodes comes in for the chief share of blame, the committee deeming that his salary of £10 per day for nine months, together with an allowance of £1,000 for expenses, was somewhat liberal, particularly as he was allowed to draw £2,000 in advance, before sailing, and that the sole achievement of his costly mission, the expenses of which amounted altogether to £4,255, was to land the company with a "loss in connection with the New Zealand Company of £18,640." Sir Julius also comes in for censure in connection with a loss through contracts for the Sellon-Volckmar accumulator of £5,656, but for this he seems only partly responsible. The committee, after showing that £27,926 must be written off as lost, reports that they are assured that all contracts now

being worked by the company are yielding a fair profit, and they think that if the company can hold out for say two years longer at most—and they believe this to be possible without any further call being made—it is probable that electric lighting will have made such progress generally that there will be a strong demand for it in the Australian Colonies, and that the company may then begin to derive a reasonable, though still only moderate, profit. To render this possible, however, they aver that a policy must be pursued the very opposite of that on which the board have hitherto acted; and, as it is scarcely reasonable to expect a body of gentlemen to submit to a sudden reversal of their policy at the instance of outsiders, the committee would recommend that, should the directors tender their resignation, it should be accepted. At the same time, they think that it may, perhaps, be expedient to retain one, or at the most two, members of the board, if still willing to serve, as a certain continuity with the past would be thereby preserved.

Mr. J. H. DUNCAN has replied to the committee's report on behalf of the original directors, supplementing the facts and correcting the inaccuracies, he says, contained in that report. The reply is somewhat lengthy, this being stated to be necessary in consequence of the omission of the committee to comply with the terms of their appointment. Amongst the most important points brought out are the following:—

The price paid for patents was fully set out in the prospectus, on the basis of which applications were received for eight times the number of shares available for allotment.

Several electric companies were successfully floated *after* the allotment of this company's shares, and for many months the fall in prices was considered as only a temporary reaction, pending the passing of the Electric Lighting Act (1883).

Sir Julius Vogel's services were secured for a fixed period of nine months. Had his recall been practicable it would have been most unwise. The appointment and mission of Sir Julius were reported at the statutory meeting in September, 1882, but none of the committee or other shareholders then suggested such a step.

The patents, although with singular indiscretion pronounced worthless by the committee, are very far from being worthless, seeing they command the cheapest and best plant yet before the public, and that which has attained the greatest financial success in practice.

The £10 10s. per diem to Sir Julius Vogel included all expenses, such as passages, hotel expenses and entertainments. The cablegrams alone, paid by Sir Julius, amounted to about £900. The prepayment of £2,000 was no departure from custom in such cases.

The prospect of floating the New Zealand Company was seriously damaged by their failure to make the Lyttleton Harbour installation a success. After that event the general manager of this company paid a visit to New Zealand to investigate all the facts, and has reported that the arrangements of Sir Julius were made with men of high standing, that the board was an exceptionally strong one, and, to use his own words, "there could be no reasonable shadow of a doubt that had Mr. Prince or some other man made a success of the Lyttleton business the company could have been floated."

The committee omit to state that it was *impossible* for the board to repudiate the contract, which was legally binding as far as third parties were concerned.

Legal advice was taken as to the liability of Sir Julius Vogel in having exceeded his instructions, but in order to establish the liability it would have been necessary to prove bad faith, and all the circumstances—including Sir Julius Vogel's personal subscription out of his own pocket to the shares of the local company—went to show his absolute good faith in the matter.

Accumulator Option.—"£5,000 paid most precipitately."—The committee have omitted to state the circumstances under which this payment was made. Incandescent lighting was in its infancy—the accumulator discovery was believed to have solved the chief difficulty—the Sellon-Volckmar patents for the east had just been sold for £100,000 to another company, which obtained large public support, and other purchasers were eager to secure the patents for Australasia. The offer to this company was limited to a fixed hour on the 15th May, 1882, the day of purchase.

The purchase was carried through after long discussion, and with the utmost circumspection, the payment over of the money being left absolutely in the hands of the company's solicitor, an experienced man of business and electrician, who was to satisfy himself before authorising Sir Julius Vogel to pay the deposit.

Agreement with Clark, Muirhead & Co.—The committee infer that the statement made by the board in December, 1883, that steps were being taken to terminate the contract, was incorrect. The notice to terminate was given on 16th April, 1883, nearly nine months prior to the board's statement, and orders under the agreement ceased fifteen months previous to that statement. The delay in coming to an amicable settlement was not on the part of the company; and the company were not materially damaged by such delay, as the agreement left them free to get their supplies elsewhere.

The directors have repeatedly stated that Mr. Clark has most consistently avoided acting in any dual capacity whatever, and the committee admit "that he did not take part in the discussion of any dealing or proposed dealing with his firm." The directors have to record their sense of the unfairness of such an insinuation—the more so that Mr. Clark's connection with the firm was patent on the face of the prospectus, upon the basis of which subscriptions were received. It ought also to be pointed out that under the agreement Mr. Clark could only have derived a profit for his firm *in proportion to the profit earned by the company.*

The directors desire to acknowledge the assistance they have received from the committee in conference upon the matter relating to the Edison Company. The value of this assistance, however, has been more than counterbalanced by the effect of the exaggerated and indiscreet statements contained in their report, which had the effect, at least temporarily, of arresting the negotiation with that company.

It is regretted by the directors that the committee, in the interest of the company, have not made more clear that, in addition to the £22,000 available cash, the book debts, stock, and other assets in Australia, shown by the committee at £25,000, are to be taken into account. It ought also to be mentioned that the stock stands in the company's books at exceedingly low prices, and if taken at anything like the prices hitherto obtained, would largely augment the amount of the company's assets.

The directors agree with the committee that another call *may* become necessary unless the confidence hitherto reposed in the company be maintained.

It must not be forgotten by shareholders that the business has been kept back in Australia by a most exceptional period of drought, involving losses on the Colonists estimated as high as £20,000,000 sterling, and also that past expenditure is now beginning to bear fruit in business which never could have been secured without "paying a footing" for it. The directors are glad that the general result of the committee's enquiry has been the same as that of the board, to confirm the expectation that electricity will be taken up with vigour in the Colonies, that there will ere long be a strong demand for it there, and that shareholders may therefore look forward to deriving a reasonable profit upon their investment.

The committee have closed their report with two suggestions, the first that the present policy should be reversed. This is incomprehensible to the directors, as for more than a year past the board has been urging forward the very work of retrenchment and husbanding of resources that the committee themselves recommend, and their present estimates of expenditure have been adopted as the basis of the Committee's own expectations during the next two years.

With reference to the final suggestion of the Committee, the directors, who are themselves amongst the principal shareholders, will not relinquish their position until they have clear indications, not from a small section of the shareholders, but from the main body of the proprietors, that in their opinion the experience of the committee is greater, and the judgment of the committee sounder, than that of the board.

India Rubber, Gutta Percha, and Telegraph Works Company, Limited.—Allotment letters with respect to the issue of 10,400 new shares of £10 each, at a premium of £5 per share, have been forwarded to shareholders registered on the 17th ult. Instalments of £5 per share are due respectively on the 14th March, 14th April, and 14th May next, interest at the rate of 4 per cent. per annum being allowed on the second and third instalments if paid on the first-mentioned date. Allottees of any fraction of a share will have to sell or buy allotments so as to make up holdings to even amounts of £10, in respect of which new shares will be issued. Upon production at the company's office, 106, Cannon Street, E.C., before the 14th inst., of fractional allotments, making up one or more new shares, an allotment letter will be issued in exchange. The new shares will rank for dividend from the 1st January, 1885, equally with the existing shares of the company.

South African Brush Electric Light and Power Company, Limited.—The creditors of this company are requested on or before the 10th day of April, 1885, to send their names and addresses, and the particulars of their debts or claims, and the names of their solicitors (if any) to Thomas Joice Seel, 5, Copthall Buildings, Moorgate Street, E.C., the liquidator of the company.

Submarine Telegraph Company between France and England (Societe Carmichael et Cie.).—The dividend at the rate of 15½ per cent. per annum for the half year ended 31st of December last, will be paid on presentation of the coupons, either at the Union Bank of London, 2, Princes Street, E.C., or to Mr. P. Gil, banker, 6, Boulevard des Capucines, Paris.

Great Northern Telegraph Company, Limited.—The interest due on the 1st inst. on the debentures of 1883 (Series B), will be paid by Messrs. C. I. Hambro and Son, at their offices, 70, Old Broad Street, E.C.

London Platino-Brazilian Telegraph Company, Limited.—Six per cent. Debentures.—The coupons due on the 1st inst. will be paid by Messrs. Glyn, Mills, Currie & Co., 67, Lombard Street, E.C.

TRAFFIC RECEIPTS.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of February were £1,457, against £1,588 in the corresponding period of last year.

The Great Northern Telegraph Company. The receipts for February, 1885, £20,400; from January 1st to February 28th, 1885, £41,200; for the corresponding months of 1884, £38,680; and for 1883, £36,440.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph Engineers and Electricians.

An ordinary general meeting of this society was held on Thursday, February 26th, Mr. C. E. Spagnoletti, President, in the chair. The minutes of the last ordinary meeting having been read and confirmed, and the list of new and proposed new members announced, the discussion on Mr. Timmis's paper, which was adjourned from the last meeting, was carried on.

Mr. Lancaster Owen asked whether Mr. Timmis's system of working points had been practically tried. The magnet which was used could hardly, he thought, be placed underground, and in many cases it would be difficult to find a place for it, unless it were placed at some little distance from the points; in which case, however, there would be a great deal of friction to overcome. He thought the magnet would be of great service for distant signals. With regard to the general scheme of working all the points and signals by the electro-magnets, he did not think such an arrangement could economically replace the mechanical system, as it would necessarily be complicated and would certainly require a skilled attendant to look after it. A great advantage in the mechanical system was the fact that all the parts were visible, so that an ordinary lineman could attend to them without difficulty, in case anything went wrong; this would not be the case with the electrical system.

Professor Hughes said that with regard to the long pull magnet, Page, in 1846, invented a system in which several coils were brought into circuit successively, so that a stroke of 4 feet was obtained; Froment, Allan, and Houdin had also devised ingenious contrivances for effecting the same object. His own electro-magnet, as invented for his printing telegraph, had been applied by Lartigue for working the engine whistle. The only defect which the Hughes magnet possesses is that the armature when released requires to be put back, which is objectionable for certain purposes.

Sir Charles Bright described Dering and De Moulin's methods of obtaining a long stroke. He thought that the latter could only be effected by employing a series of magnets which were brought into circuit in succession.

Mr. A. J. S. Adams thought that batteries could not be relied upon for working signals; he also thought that hydraulic power might be used in many cases with advantage.

Mr. Conrad Cooke stated that the Lartigue method was employed by Mr. Sykes on the London Chatham and Dover Railway with great success for working signals.

Mr. Preece said it was always interesting to know what had been done in the past, though, as a rule, this was only a record of failures. Mr. Timmis described a success. His system had been applied at Swansea, and worked perfectly. He thought, however, that Mr. Timmis had gone too far, as he had proposed to apply electricity in cases where mechanical appliances alone were far preferable. Electrical working would answer well for distant signals, but there was no occasion to apply it to home signals. Now that railway traffic was so heavy, it was necessary to divide the lengths of line into several sections, with signal boxes at each; but by means of Mr. Timmis's signals one-half of these boxes could be dispensed with, an electric distant signal being placed between two distant boxes.

Prof. Ayrton considered that the signal could be better worked by means of a small electric-motor.

Mr. Sydney Walker (through the secretary) considered that an ordinary electro-magnet could be made to do what the long pull magnet effected, if a long lever were employed.

Mr. A. Trotter pointed out that if a small motor were used as suggested by Prof. Ayrton, the time occupied in moving the signal would be proportionately longer, and therefore the amount of battery power expended in the two cases would be about the same.

Prof. Ayrton said that was so, but still the fact remained that a battery of small dimensions would effect the object, whereas with the long pull magnet a very large battery was absolutely necessary.

Mr. Beeman enquired the cost of Mr. Timmis's system as compared with the mechanical method; this, after all, was the important point.

Mr. Currie said that in a long pull magnet the forces were more advantageously applied than in the case where an arrangement of levers was used. As regards contacts, no trouble whatever was experienced on this point. He had tried a motor for working signals some time ago, but had abandoned it for the reason that inasmuch as it required only a small power to work it, a small power would stop its working.

Mr. Timmis in replying, said that he had been engaged in railway work for many years and was therefore able to speak from experience. The Board of Trade, he said, were desirous of having distant signals placed much further away from the stations than was the case at present, and also of having them capable of being set to three positions. This his electric signal accomplished. As regards the electro-magnets for working points, these could always be placed between the lines and between the sleepers, and could easily be protected. The hydraulic system had been tried in Canada and proved to be an utter failure in consequence of frost; to mix spirits with the water to prevent freezing would be out of the question as it would certainly be tampered with. The advantage of keeping the signal down by a continued current was that if anything went wrong the signal would at once fly to danger. The cost of working the signal did not exceed one farthing for the 24 hours, supposing there to be 150 trains a day. Although the horse-power expended was undoubtedly high, it was used for such a very short time that it was not worth consideration. He felt sure that a general electrical system would prove economical.

The meeting then adjourned.

Physical Society, February 28th.

Prof. Guthrie, President, in the Chair.

Messrs. G. R. Begley and O. Chadwick were elected members of the society.

Mr. J. C. McConnel presented two notes on "The use of Nicol's prism." The first note related to the error in measuring a rotation of the plane of polarisation due to the axis of rotation of the prism not being parallel to the emergent light. After pointing out that this error was to a first approximation eliminated by taking the mean of the readings in the two opposite positions of the Nicol, the author proceeded to push the calculation to a second approximation, so as to get a measure of the residual error. This is given by the equation

$$\frac{\theta + \theta_1}{2} - \psi = \text{const.} + \cdot 24\, r^2 \sin\psi \cos\psi,$$

where θ and $180 + \theta_1$ are the two readings of the circle; ψ_1 the angle between the plane pole of polarisation and a fixed plane, and r the angle between the axis of rotation and the incident light. This equation is practically correct for a flat ended as well as an ordinary Nicol. The residual error can not amount to 1′ in a rotation of 60°, if r is less than 2°. The optical properties of the Nicol tend to neutralise the geometrical error due to the rotation taking place about one axis and being measured about another.

The second note dealt with a new method of obtaining the zero reading of a Nicol circle. This is often defined as the reading when the plane of polarisation is parallel to the axis of rotation of the table of a spectrometer. A Nicol is fixed on the table, the light quenched by turning the Nicol circle, and the reading taken. The table is then rotated through 180°, the light quenched and the reading taken again. The mean of the two readings gives the result required. It was described how the error, due to the want of symmetry of the Nicol, might be found and eliminated.

Mr. H. G. Madan exhibited and described "Some new forms of polarising prisms." The first of these is by M. Bertrand, and has been described by him (*Comptes Rendus*, September 29th, 1884). The prism consists of a paralelopiped of dense flint glass, of refractive index 1·658, the same as that of Iceland spar for the ordinary ray. The glass prism is cut like the spar of a Nicol prism, a cleavage plate of spar being cemented between the two halves by an organic cement of refractive power slightly greater than 1·658. A beam of light traversing the prism is incident upon the spar at an angle of 76° 44′. The ordinary ray passes through without change, but the extraordinary ray is totally reflected at the first surface. The prism gives a field of 40°. M. Bertrand's prism has the great advantage of requiring only a very small quantity of Iceland spar, a substance that is becoming very scarce and expensive.

The other prisms shown were a similar one by M. Bertrand, described in the same paper, a double image prism by Ahrens, described in the *Philosophical Magazine* for January, 1885, and a modification of the latter by Mr. Madan, described in *Nature* for February 19th.

Mr. Lewis Wright pointed out, as a practical objection to M. Bertrand's prism, that it was very doubtful whether a glass could be obtained of so high a density as to possess a refractive index of 1·658, and at the same time be colourless and unaffected by the atmosphere. He also remarked that the principle of the prism was by no means new.

Prof. W. E. Ayrton read a paper by himself and Prof. J. Perry on "The most economical potential difference to employ with incandescent lamps." The authors commenced by pointing out the importance of experiments being made on the lives of incandescent lamps, in addition to experiments on efficiency. Referring to the experiments on life, given by M. Frussat in the *Electrician* for January 31st, they showed that if p be the price of a lamp in pounds, n the number of hours per year that it burns, $f(v)$ the life of the lamp in hours, and $\theta(v)$ the number of candles equivalent to the lamp, $f(v)$ and $\theta(v)$ being expressed as a function of the potential difference in volts, $\frac{p \times n}{f(v) \times \theta(v)}$ stands for the cost per year per candle, as far as the renewal of lamps is concerned. Also, if H stands for the cost of an electric horse-power per year for the number of hours electric force is employed, and $\phi(v)$ the number of watts per candle, $\frac{H}{746} \times \phi(v)$, stands for the cost per year per candle, as far as the production of power is concerned. The sum of these two represents the total cost per candle per year, and the value of v that makes this a minimum may be found either graphically or analytically. Solving the problem graphically, for the 108 volt Edison lamps used at the Finsbury Technical College, where n may be taken as 560, and H = £5, they find that the minimum value of the total cost is given by $v = 106$. The curve connecting total yearly cost per candle with v, they found to be very flat at this point, showing that the lamps may be burnt with a potential difference varying

as much as 4 volts with only 5 per cent. addition to the annual cost. It is found that with certain types of incandescent lamps the candle power of the lamp varies as the potential difference minus a constant. The authors also find that in rough photometric experiments No. 8 sperm candles may be substituted for standard ones.

Mr. MACFARLANE GRAY gave an account of a most extended investigation upon the second law of thermo-dynamics. From considerations connected with the specific heats of liquids and gases, the author comes to the conclusion that the law is not true. The experimental results used are chiefly those of Regnault, to which, however, Mr. Gray has applied some corrections.

NEW PATENTS—1885.

2263. "Making watertight boxes placed in the ground for the electrical testing of underground electrical conductors, and for giving origin to other conductors." E. W. BECKINGSALE. Dated February 19. (*Complete.*)

2271. "Electric current meters." J. W. SWAN. Dated February 19.

2287. "Electric accumulators or storage cells." T. S. SARNEY, A. S. HAMAND. Dated February 19.

2325. "Construction of armatures for dynamo-electric machines." F. WYNNE. Dated February 20.

2328. "Production of long range motion in the armatures of electro magnets and the arrangements or mechanism therefor." J. STEPHEN. Dated February 20.

2330. "Revolving lamps lighted by electric light for advertising, &c." A. C. HENDERSON. (Communicated by P. Lauras.) Dated February 20.

2335. "Method of telegraphing from light ships or other vessels to the shore." J. H. BARRY. Dated February 20.

2350. "Magnetic compasses." A. M. CLARK. (Communicated by Fair, Paride & Co.) Dated February 20.

2388. "Machinery for paying out or picking up submarine electric telegraph cables." W. C. JOHNSON, S. E. PHILLIPS. Dated February 21. (*Complete.*)

2395. "Resistance boxes and like apparatus for use with incandescent electric lamps and for other purposes." G. A. NUSSBAUM. Dated February 21.

2458. "Electro-telephonic receivers." A. A. CAMPBELL-SWINTON. Dated February 23.

2463. "Secondary batteries." C. S. BRADLEY. Dated February 24. (*Complete.*)

2477. "Repeaters for submarine cables." M. G. FARMER, Dated February 24. (*Complete.*)

2488. "Alarum for street and other doors, windows, sashes, &c." G. F. ANDREWS. Dated February 24.

2490. "Distributing currents of electricity." R. E. B. CROMPTON. Dated February 24.

2509. "Electric clocks." H. ARON. Dated February 24.

2555. "Apparatus for transmitting and receiving electrical signals." J. C. MEWBURN. (Communicated by M. Deprez and B. Abdank-Abakanowicz.) Dated February 25.

2564. "Electric batteries." D. T. PIOT. Dated February 25.

2572. "Electric meters." J. E. H. GORDON. Dated February 25. (*Complete.*)

2575. "Electric mains employed in district lighting." J. E. H. GORDON. Dated February 25.

2582. "Tape for covering electric, telegraphic, and other conductors and apparatus employed therein." G. F. ROGERS. Dated February 25.

2583. "Lubrication of commutator and other revolving apparatus." D. L. SALOMANS. Dated February 25.

2586. "Automatic electric switch and cut-out." H. H. S. CUNYNGHAME, O. E. WOODHOUSE, F. L. RAWSON. Dated February 25.

2587. "Electric mains employed in district lighting." J. E. H. GORDON. Dated February 25. (*Complete.*)

2593. "Electric battery." W. A. BARLOW. (Communicated by L. Encausse et Canésie.) Dated February 25.

2596. "Distribution of electricity employed in district lighting." J. E. H. GORDON. Dated February 25. (*Complete.*)

2639. "Spring terminal for electric wires." B. PELL. Dated February 26. (*Complete.*)

2651. "Liquid electric switch." A. L. LINEFF, W. JONES. Dated February 27.

2657. "Arc electric lamps." F. STANLEY, A. H. DAVIES, C. RICHARDSON. Dated February 27.

2670. "Jars or vessels for galvanic batteries, and trays or stands for same." W. DEFRIES. Dated February 27.

2671. "Dynamo machines." A. F. LINK. (Communicated by Aktien Gesellschaft Helios.) Dated February 27. (*Complete.*)

2682. "Joints used for connecting together the ends of insulated electric conductors." F. R. LUCAS. Dated February 27.

2685. "Self-locking electrical testing key. B. PELL. Dated February 27. (*Complete.*)

2690. "Improving decayed vision and hearing by electromagnetising the frames of spectacles." S. MASON, C. R. HUXLEY. Dated February 28.

2695. "Dynamic, magnetic, and magnetic-dynamic machines." A. CLARK, H. PENMAN, C. S. KIRKWOOD. Dated February 28.

2696. "Voltaic batteries." A. CLARK, H. PENMAN, C. S. KIRKWOOD. Dated February 28.

2741. "Galvanic gas batteries." G. F. REDFERN. (Communicated by A. Bernstein.) Dated February 28.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

5249. "Improvements in the manufacture of cartridges for use in electric fire arms." J. ANDREWS. Dated February 26. 6d. The cartridge employed is of the ordinary form used for central fire, and through the centre of the metal top or cap of the cartridge is fixed a short plug of vulcanite or other insulating material, and through this plug is fixed a short piece of copper wire about half an inch in length, preferably tipped with platinum. In and to the inside of the metal cap of the cartridge is fixed another copper wire, and these two wires are connected inside the cartridge with a piece of fine platinum wire which, when the cartridge is charged, is embedded in the gunpowder or other explosive material. The outside end of the copper wire, which is fixed through the centre of the cartridge, must be flush or even with the cap or head of the cartridge. When the cartridge above described is inserted in the barrel of the electric fire arm and the breech closed, the apparatus is ready for action, and the discharge is effected by pressing the push or commutator and thus closing the electric circuit, upon which the electric current will pass from one pole of the battery contained in the said fire arm to the other, and in its passage will heat the platinum wire contained in the cartridge to redness, and thus cause combustion and discharge of the charge of gunpowder contained in the cartridge as before described.

6410. "Improvements in breaking electric contact to prevent overheating by imperfect contact." Sir WILLIAM THOMSON. Dated March 10. 6d. Relates to improvements in breaking electric contact to prevent overheating by imperfect contact, that is to say, through the contact being imperfectly made or imperfectly broken in a tap or switch for electric light, the inventor uses an appliance in which gravity takes the place of the spring generally used hitherto. For this purpose he employs a plunger consisting of a stout straight wire capable of moving up and down through a sufficient range through two guide rings metallically connected with one part of the circuit to be made and broken. A spring or springy piece connected with the other part of the circuit is pressed up by the upper end of the plunger when the plunger is pushed up. The mutual pressure between the spring and the plunger gives rise to horizontal forces on the two guide rings, and the plunger is held up by virtue of the friction due to these three forces resisting its downward motion. When the plunger is pulled down so as to press too lightly on the spring to bear its weight, it falls away of itself, it being quite free to fall down through the guide rings until stopped by a pin which prevents it falling out.

12215. "Improvements in telegraphic transmitting instruments." F. H. W. HIGGINS. Dated September 9. 6d. Has for its object improvements in telegraphic transmitting instruments, and relates to the class of transmitting instruments in which a barrel with pins upon it is stopped by depressing finger keys corresponding to the letters of the alphabet and other symbols, and in which the pin barrel, when permitted to revolve, carries round with it a wheel with projections and spaces which, as it revolves, produces a succession of contacts causing currents to be transmitted through the line wire. In such a transmitting instrument the inventor provides in connection with this contact making wheel two separate contact springs, each in a separate local battery circuit, including a relay. The wheel in revolving closes these circuits alternately, and the relays transmit currents, the one positive currents, and the other negative, into the line. This arrangement obviates any tendency to vibration of the contact springs on the face of the contact making wheel, and also simplifies the apparatus. Between the relays and the line wire the inventor provides a connection with a condenser by which he prevents sparking at the relay contacts and strengthens the signals. The pin barrel, when released by the finger keys, is carried forward by a pawl dropping into teeth in a wheel driven by an electro-motor. To obtain a smooth action in starting a spring connection is interposed between the pawl and the pin barrel; when this precaution is not taken there is a risk of the first current of a series not being efficiently transmitted when working at high speeds.

13913. "Improvements in electric arc lamps." T. J. HANDFORD. (Communicated from abroad by R. H. Mather, of America.) Dated October 21. 6d. The object of the invention is to so construct, combine and connect the elements of a series of single lamps of the general character described in the specification to letters granted to W. R. Lake, dated the 5th December, 1882, No. 5796, as to make a duplex or multiplex lamp which will burn till the several sets of carbons are successively consumed and in particular to accomplish this object by means of a compound automatic switch whose contact points are the carbons of the lamp.

14476. "Improvements in electric batteries." E. G. BREWER. (Communicated from abroad by J. Cerpaux, of Brussels.) Dated November 1. 4d. The novelty in the invention consists in the employment of the different materials which are placed and superposed in the porous pot or vase. These combined materials form a new combination. They are mercury, sulphate of copper, peroxide of manganese in grains or granulated, sulphate of zinc, peroxide of manganese mixed in grains or granulated and powder, with crushed carbon from retorts, the whole covered with a layer of lead. Another part of the novelty of the invention also consists in the employment of a long lead wire inside the porous vase or pot and formed into a spiral at the bottom of the said vase or pot successively traversing all the above-named materials downwards and upwards. This lead wire thus forms two rods stopping level with the porous vase or pot, and it holds magnetically the different materials contained in the porous vase or pot.

15372. "Improvements in electric cables." H. H. LAKE. (Communicated from abroad by J. Greenalgh and P. Chase, of America.) Dated November 21. 4d. Consists essentially in covering the aggregation of insulated wires composing the body of the cable with a ribbon or strip of sheet metal, either plain or corrugated, the strip being applied spirally, and having the edges of its coils soldered or brazed together to form water-tight joints, by which a cheaper, more durable and otherwise desirable article of this character is produced than is now in ordinary use.

CORRESPONDENCE.

A Correction.

I have been waiting for the last week or two to see if a more able pen would contradict the statement regarding the electric light installation at Queen Street Station, Glasgow, in your issue of February 14th, in which you stated the said installation was carried out for Mr. R. E. Crompton by Mr. H. Mavor (now Muir and Mavor). As one who knows, I beg to contradict the said statement, as Mr. H. Mavor was not in the employ of Mr. R. E. Crompton at the time the said installation was being carried out. The installation was originally carried out by Mr. H. Thomson and Mr. J. Groves, of H. Bennett & Co., Glasgow, for R. E. Crompton, and in good working order before Mr. H. Mavor had anything to do with it. As one who was working at it from the beginning until very recently, I think I should know. I hope for the sake of giving credit to whom the credit is due, you will insert this letter in your very valuable paper.

Truth.

Glasgow, *February 28th*, 1885.

Glass Cells for Accumulators.

Can you or any of your readers inform me of the names of makers of large rectangular glass cells—say 18 inches by 12 inches by 15 inches—suitable for storage batteries.

Accumulator.

February 27th, 1885.

[The Electrical Power Storage Company could supply these.—EDS. ELEC. REV.]

Edison's Patents.

In reading the letter of Major Barney which appears in your issue of the 28th ult., I am struck by two things, viz.: 1, his want of perception of the most obvious principles of British patent law; 2, his lack of modesty in casting reflections on persons who for years have made that law their special study. One would have thought after Major Barney's experience on a former occasion, when I unfortunately became involved in a controversy with him, that he would have hesitated before again entering the arena; but it would appear that, although in the course of the correspondence which then took place I convicted him, yet that I failed to convince him of his egregious mistakes, as, nothing daunted by his former discomfiture, he returns to the charge with renewed vigour.

I do not, however, intend to gratify Major Barney by attempting on the present occasion to traverse his absurd statements, as I think your readers must be pretty well tired of these personal altercations; and as, moreover, the plain and palpable proofs which I brought forward in support of my views in the former controversy apparently had so little effect on Major Barney, you will be disposed to agree with me that it would be a sheer waste of my time and of your valuable space for me to endeavour to adduce further arguments on the point now under discussion. If, therefore, Major Barney believes he is free to use any and every apparatus which is the subject of a disclaimed claim, I shall leave him to enjoy his fool's paradise, in the confident expectation that, wrapped up in his pleasing delusion, he will shortly find himself mulcted in heavy damages for infringement, which will probably "enlighten" him more than any words of mine can do as to "what is the effect of a disclaimer."

Thos. J. Handford.

42, Southampton Buildings,
March 2nd.

[We thank Mr. Handford on this, as on other occasions, for the light he invariably sheds on the matter at issue, and we think that the time has now arrived when correspondence on the Bell and Edison patents might very well cease. The numerous points involved, *pro* and *con*, have been so well threshed out, that unless something new should transpire we must refuse to insert any further communications bearing upon these matters.—EDS. ELEC. REV.]

Positives or Negatives.

I thoroughly sympathise with your correspondent "X," as to the confusion which exists in the nomenclature of the plates in a secondary battery, and well remember the hopeless muddle I was in when first trying to understand the action of an accumulator as expounded by different authors.

It appears to me that in this, as in everything else, it is impossible to please everybody, and that, therefore, the matter should be determined by pure practical considerations, the aim being that no harm shall result from mistaken notions.

There are then two classes to consider, the practical man and the scientific. By the former I mean the man who has to fix the cells or make them. Everyone who has had much to do with the "British workman" knows that, to get him to understand anything new, you cannot be too explicit; and the sudden demand which has sprung up for men to install or work electric apparatus, has made it necessary to take men from other trades, and instruct them in running wires, fixing dynamos, and, more recently, accumulators.

In the wire running, for instance, you drum into your newly acquired joiner that with lamps run in parallel he will have two wires run side by side, but not touching, one the positive and the other the negative, and that all branch wires connected to the positive will also be positive, and the same with the negatives.

This he masters, and is forthwith a full-blown electrician, and as likely as not, when the job is complete, he is offered by your client more wages than you can afford to give him to stop and work the apparatus. Then, either because the light is unsteady, or because people object to the engine running half the night through for some half dozen lights, an accumulator is ordered, and he proceeds to fix it.

The instructions are clear enough as to how to connect the cells in series, but what next?

He finds a terminal marked (+), and is on the point of connecting this to the rest of its kith and kin, when he comes across a clause telling him something about

the brown peroxide being negative. There is no mistaking the brown colour of the plates: they are branched off from a main conductor like his wires, and remembering his sermon on wire running, he is fairly floored.

However, the lights have to be going, and as he knows his wire running rule held good, he concludes the pole is marked wrong, so on it goes to the negative of dynamo.

Then we hear that after several hours charging he got scarcely any light.

The scientific man is naturally made very unhappy by anodes and cathodes not getting all they are entitled to, but beyond, perhaps, spoiling his appetite for dinner, I don't see that much harm is done, and inasmuch as ninety-nine men are interested in the external circuit of a battery, to every one scientific man who studies the internal action, it appears to me that electric lighting interests will be more benefited if the workmen are not led to make mistakes.

Let the peroxide plates be called *positives*, and let this be taken as synonymous either to "positive pole plates," or "positive negative plates," or "positive terminal negative plates," according to the taste of the speaker, and the time at his disposal, but do not worry the practical man by trying to show him how his positive wire, though it remains so all over the rest of the circuit, suddenly changes into a negative, as soon as it comes into contact with sulphuric acid.

Y.

The Theories about Electricity.

In your number of last Saturday there is an article on "Induction and Conduction" from the pen of Mr. Willoughby Smith, which I would not have written to you about but for the sake of the interests of science. For 46 years I have, through the public journals, endeavoured to keep before the view of electricians facts which prove that the theory of two electricities is wrong, and that there is only one electricity, and that it is not the one electricity of Franklin, who alleged that electricity possessed within itself the power of repulsion.

In scientific journals, both in this country and in America, experiments of mine have been published with the view of proving the accuracy of my theory; and recently in the *Engineer* there was published a letter of mine requesting other electricians to repeat my experiments, the more especially as the apparatus required is of a very commonplace kind, and is in the possession of most electricians. No response has been given to that letter, that I am aware of, until I read Mr. Willoughby Smith's article in your columns containing the following passage:—"I cannot but express my surprise and regret that the clear views of Faraday have not, long since, received that general acceptance which I venture to assert they so richly deserve, and also that even at the present day theories are propounded which, although marked by the sincerity of the propounder, will not bear even the dullest light of criticism."

If Mr. Willoughby Smith can show that these remarks are not intended to refer to my theory of electricity and experiments I will apologise to him and you for troubling you with this letter. But if I am right in assuming that Mr. Smith directs these words against my theory of electricity and experiments, it becomes my duty to direct his attention to the Scotch proverb, which says "Facts won't ding," which means that facts cannot be knocked down. Now by Mr. Smith's writings he is trying to knock down facts instead of facing them. He experiments with electricity, and is therefore the very party who should repeat my experiments, and give to the public the result of his trial of them. If he will do so, he will be performing something that will advance the cause of the science of electricity.

James Johnstone.

8, Dalhousie Terrace, Edinburgh,
March 3rd, 1885.

Storm in Aberdeen.

I was much surprised to read in your last issue that the Aberdeen telephone system "completely collapsed" under the influence of the storm of February 21st—22nd—surprised because, although possessing possibly good means of knowing what the effect of the storm really was, I was quite unaware that anything so serious had occurred until I read of it in the REVIEW. It is a fact that one route—that extending from Footdee along the quays and Union Street to Dee Street—was very badly damaged, but this no more led to a collapse of the system than the blowing off of your hat, Mr. Editor, would lead to the collapse of the REVIEW. The company own 735 poles, 86 standards, and 245 miles of wire in Aberdeen. Of these, 13 standards, all on one route, with the wires they carried, were damaged. On other routes the mischief done was insignificant, and was confined to the breakage of wire. The addendum that "a railway porter was struck by a falling wire and sustained a severe cut across the shoulders" has no foundation in fact. If not an entirely mythical personage, the porter must have been hit by a slate, not a wire. The statement that a man was badly cut—through coat, vest and shirt, of course—by the descent of a No. 18 wire, weighing 38 lbs. to the mile, is palpably absurd. No such accident has been reported to the company.

The storm, owing to the fact that, at the time of its occurrence, the No. 18 wires were more than an inch in diameter with ice and snow, probably constituted the most severe test to which a telephonic system has ever been subjected to in this country, and the company have no reason to complain of the manner in which their work withstood it.

A. R. Bennett,
General Manager for Scotland.

National Telephone Co., Limited,
8A, Royal Exchange Buildings,
Glasgow, *March 3rd*, 1885.

[We are pleased to see from Mr. Bennett's letter that our account of the storm, rendered even though it was by a correspondent in Scotland, was an exaggerated one.—EDS. ELEC. REV.].

Telegraph and Telephone Circuits.

It is proposed to run a telephone wire on posts together with telegraph wires, a distance of five miles.

Would a return run about a foot from line wire entirely prevent the inductive effect of the telegraph currents?

And would such a return at all affect the speaking of the instruments?

H. E.

Castle Street, Dingwall,
2nd February, 1885.

The Electric Light at Temesvar.

With reference to the article in your issue of February 28th, on the subject of the electric lighting of the streets of Temesvar, in Hungary, I am directed by my board to draw your attention to the fact that the installation in question was carried out by the International Electric Company, Limited.

The lighting continues to give complete satisfaction, and this company has entered into a contract with the Municipality of Temesvar for the electric lighting of the whole of the town, and the supply of the electric light to private consumers for a term of years.

Kindly insert this explanation in your next issue.

Frank Schlœsser,
Secretary, the International Electric Co., Limited.

4, Copthall Buildings, London, E.C.,
March 3rd, 1885.

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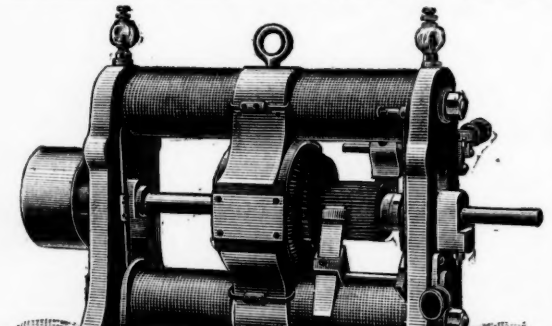

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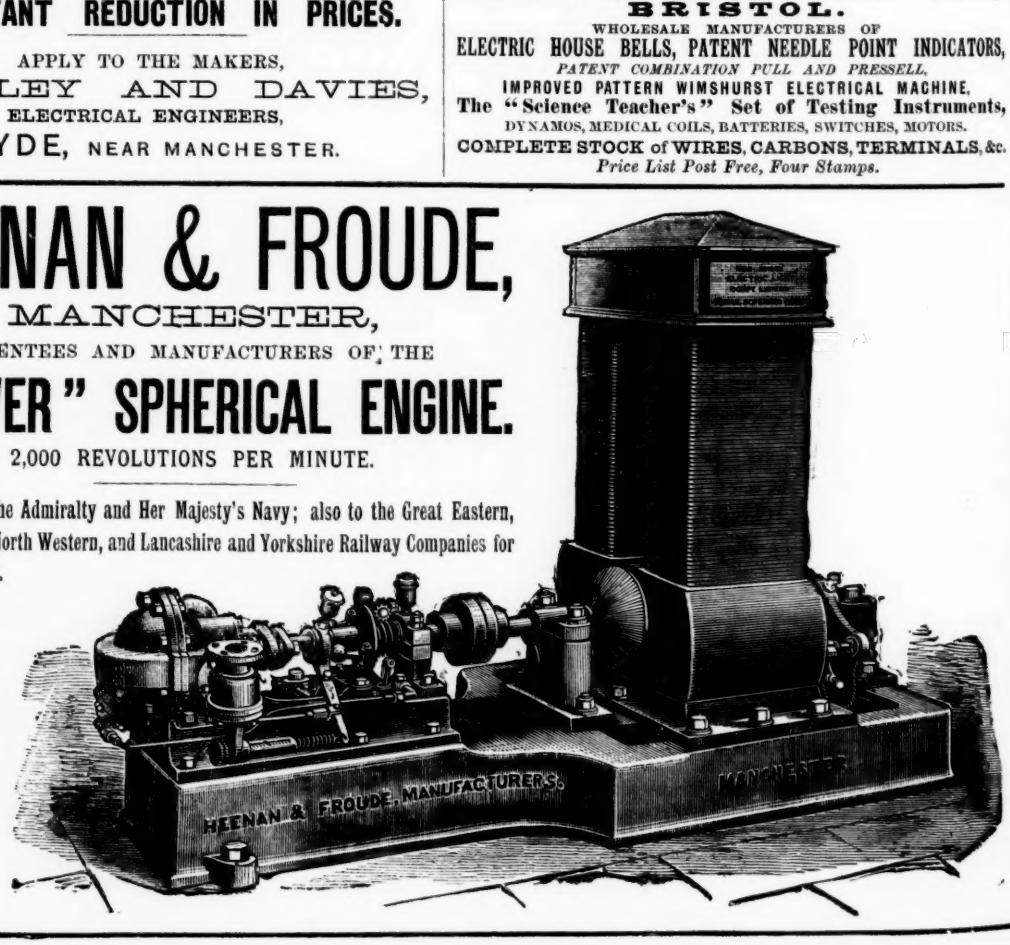
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